SEVENTY-FOURTH YEAR

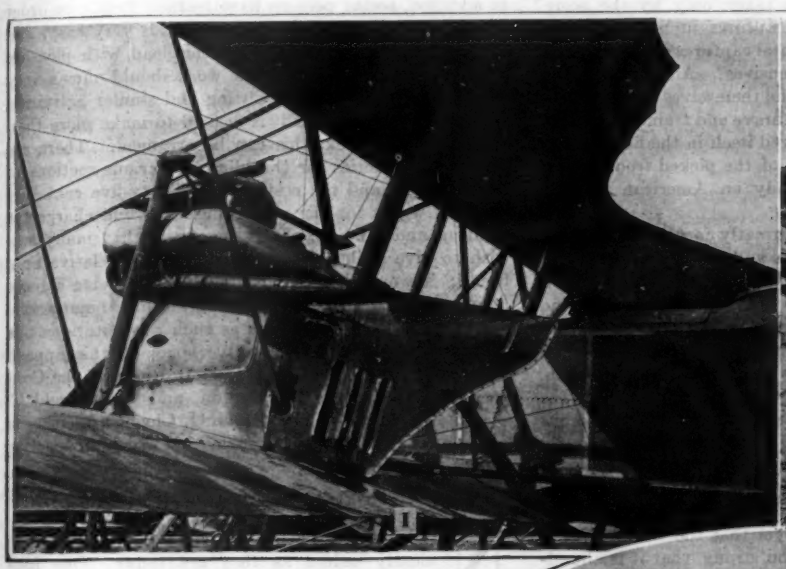
SCIENTIFIC AMERICAN

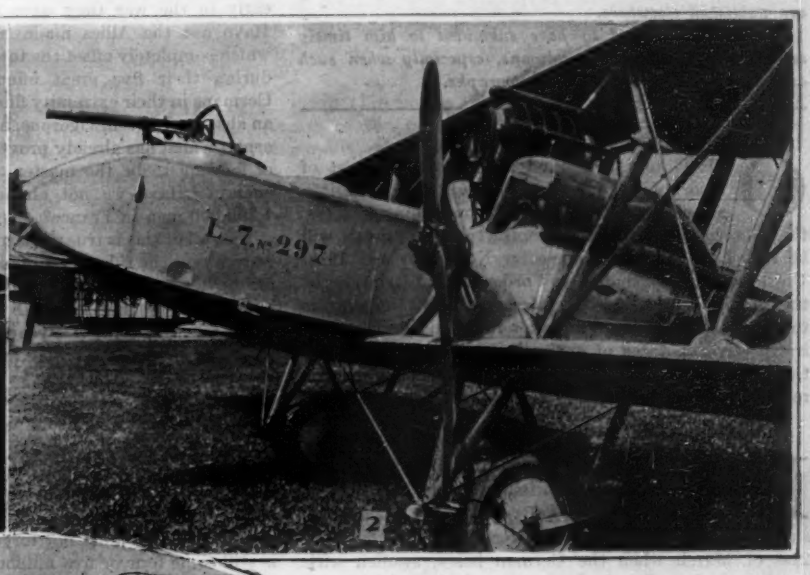
THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

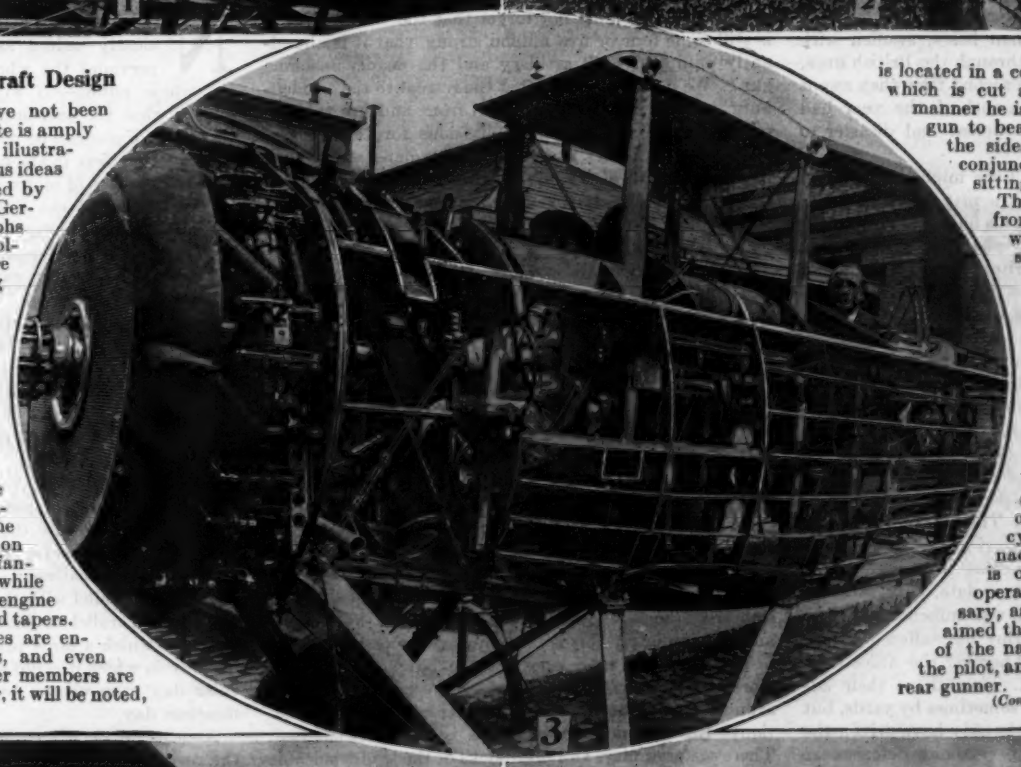
VOLUME CXIX. NUMBER 12

NEW YORK, SEPTEMBER 21, 1918

10 CENTS A COPY
$4.00 A YEAR







Oddities in Recent Aircraft Design

THAT aircraft designers have not been resting on their laurels of late is amply proved by the accompanying illustrations, showing new and ingenious ideas in aircraft design as exemplified by certain leading French and German types. These photographs have been selected from a collection of some fifty or more photographs, depicting nothing short of marvelous development in French airplanes. And no doubt the same holds true of British, Italian, German, and other planes which are engaged in the war of the skies at the present time.

The first photograph of the accompanying collection shows how stream-lining has been carried to the extreme in the latest Letort plane. The engine housing or nacelle for the V-type stationary engine on either side terminates in the fantastic prow-like end as shown, while the cylinder housings and the engine exhaust both end in stream-lined tapers. The majority of the guy wires are enclosed in stream-lined casings, and even exposed pipes, joints, and other members are stream-lined. The rear gunner, it will be noted, is located in a cockpit clear of the upper plane which is cut away at the center. In this manner he is enabled to bring his machine gun to bear on targets at the rear, over the sides, and overhead, alone or in conjunction with the machine-gunner sitting in the front cockpit.

The second photograph is a front view of the Letort biplane; which, aside from its fantastic stream-line engine nacelles, has several novel features. In the first place, it is a three-seater twin-engined machine intended for photographic and reconnaissance missions. Its planes are back-staggered; that is to say, the upper plane is farther back than the lower one, and the struts rise backward instead of forward or perpendicularly. A circular form of radiator is employed on this No. 7 model of the Letort type, between the cylinder casings of the engine nacelle. The forward cockpit is occupied by an observer, who operates the Lewis gun when necessary, as well as a camera which is aimed through a well in the forward end of the nacelle. Behind the observer is the pilot, and still farther behind comes the rear gunner.

(Concluded on page 236)

Recent progress in aircraft design as disclosed in French and German types

SCIENTIFIC AMERICAN

Founded 1845

Published by Munn & Co., Inc., 233 Broadway, New York, Saturday, September 21, 1918

Charles Allen Munn, President
Orson D. Munn, Treasurer, both at 233 Broadway

Entered at the Post Office of New York, N. Y., as Second Class Matter
Trade Mark Registered in the United States Patent Office

The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Announcement

OWING to the marked advance in the cost of labor, of postage, of paper and other materials, affecting every branch of the publishing business, the subscription price of the SCIENTIFIC AMERICAN will be raised to $5.00 per year after November 1st, 1918. Until that date we shall accept orders for subscriptions at the present rate of $4.00 per year. This offer applies to both new and renewal orders. Renewal subscriptions, irrespective of dates of expiration, will be accepted at the present rate of $4.00, provided the remittance is received by us before November 1st, 1918.

Conservative Optimism

NO period of the great world war, since its opening horrors in France and Belgium, has been marked by such dramatic results as the past spring and summer campaign on the Western front. From the 21st of March when the German hosts, swollen with contingents from Russia, burst through the British lines, to the 18th of July, when for the second time they swept beyond the Marne River, each month of the year had brought its record of successive defeat and disaster to the Allied armies.

Germany was jubilant, as well she might be, and her last great attack, hurled against a fifty-mile front was announced by the enemy as being his final peace offensive. The Germans struck with a confidence born of four successful drives into enemy territory; and, so far as an onlooking world might judge of it, she seemed to be in a fair way to blast a road into Paris itself. But the Blonde Beast from the North was not destined to repeat the triumph of his forbears of 1870. The Champs-Elysées and Arc de Triomphe were not fated, as in 1870, to echo to the clatter of Uhlan cavalry or the tramp of German troops. Nor was the modern Attila, drenched with the blood of 10,000,000 slain, to stand as conqueror in the fairest city of the world and impiously render thanks to the Almighty for the success of German arms.

Over night, between Chateau Thierry and Soissons, General Foch with a French-American army struck a blow which turned apparent defeat into indubitable victory; and from that momentous date, July 18th, on which the great counter-offensive was launched, down to the present hour, the German army has suffered an unbroken succession of defeats. Wherever the Allies have struck they have gone forward. Sometimes their advance has been marked by miles, sometimes by yards, but always during the past two months they have driven the enemy backward towards his permanent defenses at the Hindenburg line.

The fruits of these victories are more than material, they are moral as well. It was something to capture over 150,000 men, 2,000 guns, and vast supplies of stores and munitions; but it was much more to shake the morale of the German people and the confidence of the German high command to its very foundations. Save for the defeat of their armies at the first Battle of the Marne, and in the Somme battles of 1916, the German people had been accustomed to see their troops pressing victoriously forward, or standing like an impassable wall on foreign soil. Suddenly, in the very hour of supreme victory, and just as the Kaiser seemed about to march imperially into the enemy's capital, they behold their armies arrested and thrown back, with losses of men and guns and with a confusion of retreat which must have approached at times the conditions of a disorderly rout.

There is no doubt that the discouragement which shows itself among the captured soldiers at the front is reflected among the civilians at home; for the various interviews, proclamations, etc., which emanate from high quarters in Germany calling upon the people to stand fast, prove beyond a question that the morale of the German nation has been rudely shaken.

Nevertheless the war is far from won, and the task of driving the still numerous and powerful German armies out of France and Belgium and across the Rhine is one which will call for the utmost efforts, not merely of France, Great Britain and Italy, but of the United States as well. Let us make no mistake about the indisputable fact, that so far as the United States is concerned, we shall have to put our maximum strength into the war, if, in concert with our Allies, we are to force the German nation to its knees, and bring about that peace by victory in 1919, which is the only peace that we and our Allies can ever consider.

We are prompted to write in this strain by the fact that there seems to be a growing belief that the war will end this year. Superficially, such optimism might seem to be justified. Has not Marshal Foch outgeneraled the German Great General Staff? Has he not gained and held the initiative? Is he not striking just where and when he will, and always with good results? Are not German prisoners being taken by the thousand where early in the war they were taken only by the score? Have not the Allies made captures in men and guns which completely offset the total captures of the Germans during their five great offensives? And do not the Germans in their extremity find themselves confronted by an absolutely fresh, vigorous, brave and trained American army, which has already proved itself in the fiercest kind of fighting to be the master of the picked troops of the enemy? Have we not already an American force of 1,750,000 men in France?

Yes, all of this is true; it is greatly encouraging; and it proves that the tide has turned and that the Allied armies are on the road to final and complete victory. But it does not mean that the final victory is already won and that peace will come this year. Peace will not come this year and it will only come next year, as we have said, if the United States puts every ounce of its strength, naval, military, financial, industrial and moral, into the task. It is the magnitude of this war, the ponderous inertia of whole nations in arms that forbids quick decisions. Absolutely decisive results, such as followed Austerlitz or Jena, cannot now be achieved in a single battle and are difficult to obtain even in a whole season's campaign. We must not forget that the German army is still some four or five million strong, that it is abundantly equipped with artillery and the deadly machine gun. We must not forget that the retreat to the Hindenburg line has shortened the total front and has thereby released some ten or twelve divisions for the reserve. We must not forget that, as the Germans are pushed back, the length of the line that they must hold will yet further decrease, and that thus, automatically, a reserve will be built up for use at critical points in the future battle line.

Let us keep the above facts clearly before our eyes. Nothing would be more fatal to our success than an exaggerated optimism that would slow up our efforts. Let us be conservative, even in our optimism.

Books for Blinded Soldiers

ON another page we carry an article designed to show just what the Braille type for the blind is, and how reading matter in it is produced, both on a large and a small scale. On the face of the facts there brought out, it is plain that to the hundreds or thousands of men who have have lost their eyes in the fight for world-freedom, knowledge of this alphabet is the first and most important thing that can be given. But mere ability to read Braille is not worth much to the sightless man if reading matter printed in it be lacking; and unfortunately this is far too often the case.

There are the magazines for the blind, one in New York and one in Paris, and which are on a sufficiently sound financial footing to insure their continued publication. But the number of books is obviously limited. There are grammars and text-books of the trades suitable for the blind; there are a handful of classics, a few titles in adventure and biography, some novels; but the brutal truth of the matter is that Braille books do not circulate in sufficient quantity to make their manufacture attractive from a business viewpoint. Moreover, the demand, since 1914, has increased beyond all possibility of meeting it with the facilities at command. The capacity of the few Braille print-shops is exhausted in supplying the bare necessities of reëducation; books for light and general reading have had to go by default. And Dr. Eliot to the contrary notwithstanding, the reader will probably agree that it would be most distressing if the entire reading public were, like the blind population, reduced to a diet of two magazines and two thousand books on all subjects combined.

The situation thus outlined has been confined to the countries in the war because, to put it in cold blood, there are not, from ordinary cause, enough blind persons to make possible very great efforts in their behalf. But we are now in the war, and the situation will soon exist here as in Europe. Already we have under construction near Baltimore a complete hospital-school for returned sightless soldiers, with several prospective inmates awaiting its completion, and of course many more to come. It is accordingly most essential that a plan be worked out whereby the ordinary reading matter in Braille which can be supplied these men through the ordinary channels be supplemented by lighter books. These would be in the nature of scrap-books, a few pages in length, containing items of interest such as short stories, letters, jokes, verses, bits of scientific or other information—just the sort of stuff which abounds in every successful periodical or newspaper.

The attempt to furnsih such reading matter to the patients and pupils in the rehabilitation stations for blinded men is one which cannot be made by official means, and one at the same time which can with peculiar appropriateness and effect be made privately. Books of the sort described can actually be made at home, in single copies, by means of the Braille typewriter or slate which we illustrate in our article upon the subject. The former costs from fifteen to twenty dollars; the latter less than two dollars. In many large cities the services of blind persons are available for this work; in addition, seeing persons have learned Braille in order to engage in the work. The learning is very easy, and any one who wishes can follow this lead with pleasure to himself and to others. The work should offer a very attractive alternative to knitting and similar activities.

On the other hand, if it is desired to make more than one copy of a book, this can be arranged. There are publishing societies for the blind in various sections of the country; and the cost is low—thirty-five cents per hundred words for the plate, plus a trifling charge for printing and binding. It is suggested that many will wish to give such books in memory of a relative or a friend; it would indeed be difficult to conceive a more fitting memorial. The whole program has the approval of the Surgeon General, and is such a meritorious one that we do not hesitate to give space to this appeal. It is engineered by Mrs. Gertrude T. Rider, of the Congressional Library in Washington, and Mr. Harold T. Clark, 1201 News Leader Building, Cleveland, either of whom will give any further information which prospective donors may desire.

Motorless Sundays

NEVER were the people of the United States so closely united as they are today. One idea pervades the whole country, one aim actuates the whole public—to win the war for democracy no matter what the sacrifice. If any enemy alien doubts this unity of purpose he needs but take a walk on a bright Sunday anywhere in the eastern part of the country and note the absence of motor driven vehicles. The response to the request of the Fuel Administrator that, east of the Mississippi, Sunday be regarded as a motorless day, was practically universal. It was a voluntary act on the part of passenger car owners, and showed clearly the determination of the American people to see the war terminate in victory for the Allied cause.

Splendid as has been this demonstration of patriotism, many are beginning to wonder whether it is not asking a little too much of the man who must work early and late six days of the week, to give up the only day in seven in which he can obtain much needed recreation in his automobile. To be sure, it is difficult to make any restrictions that will be perfectly fair to all. At the same time in making any restrictions care should be taken to distribute the burden as widely as possible.

In order to conserve food we have had our meatless days and our wheatless days, but this form of conservation is not parallel with that of the motorless day. To arrive at a parallel we should have to conceive of a condition in which a large proportion of the public had but one day in which it could eat meat, and that this particular day were chosen by the food administrator as a meatless day.

Another plan of conservation is to be found in the restriction of the use of sugar. We have no sugarless days and yet big savings in sugar are made by restricting the amount that each individual is entitled to use. Why could not the same idea be carried out for the conservation of gasoline? Every motor car in the country is registered; every car owner is registered; every chauffeur is registered. It would seem a comparatively simple matter to issue cards to the owners of motor vehicles, entitling them to the use of a certain amount of gasoline weekly, per car, dependent upon the horse-power of the motor. Garages, and other distributors of gasoline could then be required by the Government to punch the card at each sale and to furnish no gasoline to a man who did not present his card, or who did present a card showing that his allowance for the week had been already purchased. A check could be kept upon the garage by furnishing it with a limited quantity of gasoline, based upon its average previous purchases. In this way the Government could control the whole gasoline situation and effect the requisite savings of gasoline, at the same time distributing its restrictions over the entire consuming public. This would be fair to the man with only one day per week in which he could enjoy his motor vehicle, as well as to the man who can take his car out every day of the week. The individual would then be at liberty to use his allowance of gasoline wherever and whenever he saw fit.

Industrial Efficiency

Shortage of Adhesives in Germany.—*The Zeitschrift fur angewandte Chemie* states that raw bones are now being made into glue by treatment with sulfur dioxide, the fat being removed with benzine and the mass being boiled in water under pressure. The resulting substance is a very good glue. German papers contain numerous advertisements for glue and other adhesives. Frequently the advertisements state that the material is required for army orders. It is understood that no more animal glue is being released for the civilian shoe trade except in limited quantities for the manufacture of artificial sole leather, but that this material is reserved exclusively for factories which are working on military orders.

Some Reasons for Sugar Shortage.—The following reasons for the recent sugar shortage are given by the U. S. Food Administration: 1. Disappointing sugar production from the last beet and Louisiana cane crops and disappointing yield in Porto Rico. 2. Inability of the United States and her allies to secure supplies from Java, as our great Army program has reduced our sugar-carrying fleet. 3. Exhaustion at beginning of year in sugar supplies in home, store, factory and bakery, which left a void requiring an immense amount of sugar. The mere filling of this void took up all surplus. 4. Sugar requirements for the Army and Navy and for neutrals under trade agreements, also for France and Italy, have been materially increased over earlier estimates. 5. Destruction of beet factories in French and Italian territories overrun by Germans. 6. More than 50,000,000 pounds of sugar destroyed by submarines off our Atlantic coast. Clearly, the situation is so serious that every means of conserving sugar should be adopted. Household consumption for other than preserving should be kept under two pounds per person per month. Preserving and pulping without sugar should be done as much as possible. With increased supplies after November 1st, and yet more plentiful after January 1st, sugar may be added to make the fruit palatable.

Fires from Dust in Clothing.—In chlorate-manufacturing plants the men who are exposed to the dust of the chlorate have to wear special clothing while they work, and all parts of this apparel that consist of cloth should be washed daily, in order to prevent the accumulation of chlorate dust in the interstices of the fabric. If this precaution is omitted, and the clothing is allowed to accumulate dust, a slight amount of friction against it is likely to cause it to take fire and to burn furiously. To protect the men in case of accident of this kind, large open tanks of water are often provided in the room where the crushing is done, and in any other rooms in which similar mishaps may occur; so that a man whose clothing takes fire can run quickly to the nearest tank and jump into the water. Convenient means of this kind for extinguishing burning clothing are important, continues *The Travelers Standard*, and should not be neglected; but everything possible should be done in the way of diminishing the source of the danger, so as to minimize the likelihood of a fire. For example, dust hoods and other devices for reducing the dust to the lowest possible point may often be installed with great advantage. The dust from chlorate of soda makes clothing much more readily inflammable than that from chlorate of potash, partly because the soda compound produces more dust in the crushing and grinding operations, and partly because it contains a higher proportion of oxygen.

Safety Nets for Structural Work.—The Safety Department of the Industrial Accident Commission of the State of California, believing that a man doing useful work at a height of several hundred feet needs as much protection as a trapeze performer in a circus, has been responsible for the introduction of safety nets in building construction in San Francisco. The California law requires the use of temporary plank flooring on each floor of a structure in course of erection for the protection of workmen from injury by falling objects. In special cases, however, such as auditoriums, high balconies, galleries, arch trusses of theatres, churches, armory buildings, railroad train sheds, towers, viaducts, bridges, domes and cupolas, it has been found impracticable to comply with the legal requirements. In these cases the distance to the floor is so great that men are liable to serious injury by falling or having materials fall upon them. After devoting considerable attention to this accident hazard, the California Safety Department decided that the use of rope safety nets would afford a measure of protection for workmen and has, therefore, ordered the use of the safety nets on all structural work where plank flooring is not practicable. The safety nets, continues *Safety*, are similar in character to those used by circus performers, as well as by fire departments in the larger cities in rescuing persons jumping from high windows. The nets are made of ½-inch manila rope with ¾-inch border and four by four inch mesh. They come in 10 by 30 feet sections, the borders having loops at intervals, so that they can be readily combined and attached to convenient points on the structural frame. The cost is nominal.

Astronomy

The New Dominion Astrophysical Observatory at Victoria, B. C., was opened June 11th by the lieutenant governor of the province, in the presence of leading government officials and visiting scientific men, including Dr. Swasey and Dr. Brashear, who were, respectively, responsible for the construction of the mounting and the figuring of the mirror of the great 72-inch reflector, the second largest in the world. The observatory, under the direction of Dr. J. S. Plaskett, has since been at work chiefly on measures of stellar radial velocities.

The Lost Asteroid Aethra.—Some time ago prominence was given in astronomical circles to the suggestion that an object photographed at the Lowell Observatory on June 10th, 1913, might be identical with the long lost minor planet Aethra. (See SCIENTIFIC AMERICAN, Nov. 18th, 1916, p. 453.) This suggestion has now been discredited by the examination of a series of photographs of the region in question taken at Cordoba beginning December 1st, 1916, on which no moving image has been detected. Miss A. E. Glancy, who has recently discussed this subject, points out that the orbit of Aethra is very uncertain, as it is based on an arc of only 22 days, following its discovery in 1873, by Watson. It is possible that Aethra's orbit has been perturbed by that of a larger asteroid, or it may have eluded rediscovery on account of its high inclination and eccentricity or because of a large unknown variability in brightness.

Statistics of Solar Prominences.—One of the most notable of all publications on solar prominences constitutes a memoir of the Kodaikanal Observatory, in India, issued last year. This memoir, prepared by Mr. and Mrs. Evershed, records nearly 60,000 prominences observed at the Indian observatory during the years 1904-14, together with 11,000 observed during 16 years at Mr. Evershed's former station, Kenley Observatory, England. All prominences down to the smallest visible are recorded, whereas at most other observatories only those of 30 seconds and over are recorded. It is found that many small prominences make up in brightness for what they lack in height, so that their inclusion is of real significance. Prominence activity is expressed in the Evershed memoir, not only by the number of prominences but also by profile area. The period covered by the Indian records is the length of an average sunspot cycle and the data furnish a means of comparing sunspot and prominence activity. The prominence curve bears a close resemblance to the sunspot curve, but prominence maximum is reached earlier than sunspot maximum and is longer sustained. Special attention has been paid at Kodaikanal to the puzzling fact that prominences are more numerous and denser on the eastern side of the sun, as seen from the earth, than on the western side. This has recently been explained by Sir Joseph Larmor as due to the fact that, as the outer regions of the solar atmosphere rotate faster than the inner, prominences acquire a slope forward in the direction of the sun's rotation, and therefore have a different aspect according as they are seen on the receding or the advancing side of the sun. The Indian data confirm in general the relation, pointed out by Dr. Lockyer in 1903, between the latitudes of prominences and the form of the corona, as seen at eclipses.

The Astrographic Catalogue.—The progress of work on this international undertaking is described in the last annual report of the council of the Royal Astronomical Society. It will be recalled that an astronomical congress which met at Paris in 1887 arranged for the preparation of a photographic chart and catalogue of the entire heavens, the work being allotted to 18 observatories. The photographs, all taken with 13 inch telescopes, cover an area of four square degrees each and, including duplicates, will eventually number about 25,000. Parts recently published include the second volume of the Rome zone, containing the measures of plates whose centers are at declination 63 degrees N. The plates of this series are measured at Rome, while the work of reduction and publication is done under the supervision of Professor Turner, in England. A recently published volume of the Catania zone covers the region in declination 48 to 50 degrees N., and in right ascension 0 h. to 3 h. Catania Observatory has published six of its 64 parts. The Helsingfors zone (plate centers 46 to 40 degrees N.) is about three-eighths completed. Paris Observatory has recently published a volume comprising the whole zone of plates whose centers are at declination 21 degrees N. Of the area allotted to the four French observatories, Paris, Bordeaux, Toulouse and Algiers, including zones with plate centers from 24 degrees N. to 2 degrees S., about one-half has now been published. As to the part of the work relating to the southern hemisphere, the Tacubaya Observatory has recently began publication, and extensive sections from the Cape and from Hyderabad are in course of publication. At Greenwich, Helsingfors, Potsdam and possibly some other observatories, the work is being extended by determining the proper motions of stars by direct comparisons of two plates taken several years apart.

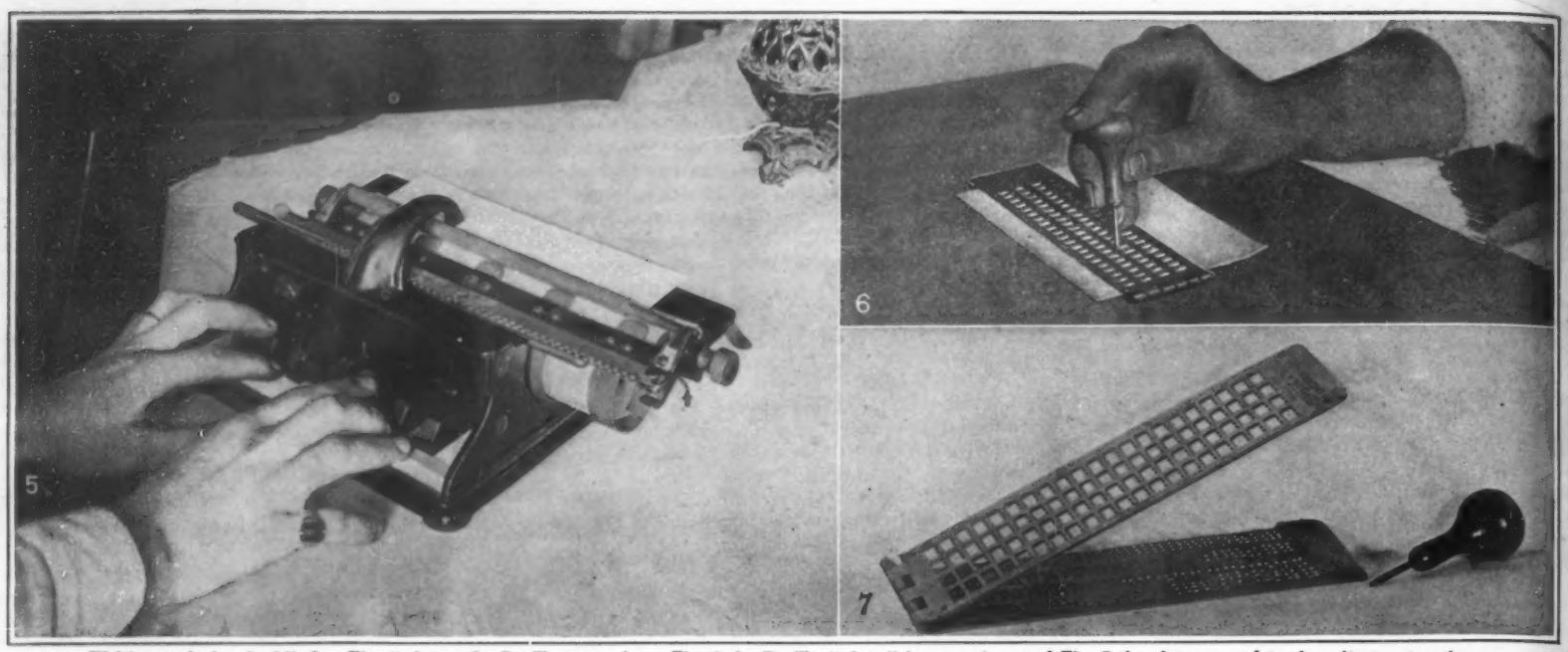
Automobile

Saving Gasoline.—A good example in saving fuel has been set by the Fifth Avenue Coach Co., of New York, which operates about 250 large buses. An economy campaign was instituted among its drivers, and within a month the consumption of fuel had been raised from 6 miles per gallon to 9.8 miles. Only one man reached this mileage, but it demonstrated the possibilities, and all of the other drivers showed decided improvement. The saving, in the aggregate, was about thirteen gallons per week for each bus, with good prospects of further economy. In securing this improvement no new parts of any kind were installed, but it was effected entirely by keeping the machinery in better order, and by the drivers exercising more care and intelligence in their work. These vehicles weigh 16,000 pounds when loaded, and are required to stop on an average of ten times to the mile, so it will be seen that the service is particularly difficult; but if such economy can be secured in such work, it must be much more easily possible in the case of heavy vehicles generally.

Road Transport of the Future.—The developments of the past year have demonstrated that our much-advertised good roads were built for joy riding, and were not designed with a view to commercial use. To meet the transportation crisis the problem will have to be considered from two points of view; either the weight, size, tread and speed of trucks will have to be strictly regulated, or the roads must be built strong enough to carry any traffic. It is evident that the latter proposition is not feasible, for there are limitations even in the work that it is desirable to impose on railways; so it would appear that a compromise must be effected between the two propositions that will permit of the greatest amount of traffic reasonably possible. In considering methods of future construction modern utilitarian tendencies would indicate that the demands of the commercial vehicle should be given the preference, but on the other hand, any method of surfacing that facilitates passenger traffic would be to the advantage of the truck, and the question between the two classes of traffic is largely one of surface. In any case changed conditions and future developments in motor transportation should be kept strictly in mind, and as little temporary work done as possible.

Grease vs. Oil.—Discussions arise periodically regarding the respective merits of oil and grease as lubricants for some portion of the mechanism of an automobile, and their various characteristics are discussed at length. One point of difference, however, which is derived from bicycle experience, has apparently been overlooked. When oil is used as the lubricant for the bearings of a bicycle, some of the oil works out into the narrow joint of the bearing, where it collects considerable dust and grit; and when the wheel is idle, this oil has a tendency to run back into the bearing, carrying with it the accumulated dirt. With grease, on the other hand, there is no such tendency of the lubricant to work back into the bearing, but its movement is constantly outward, and it constitutes an excellent protection to the bearing, notwithstanding the unfavorable impression created by the amount of dirt seen on the outside. When oil is used, distinct evidences of grit can be found in a ball bearing after a week; while in the case of grease the bearing remains clean indefinitely. Of course it may be demonstrated that grease offers more resistance than oil; but practically this is of slight consequence in many cases. In many chassis bearings, where there is a pumping action, grease might work to better advantage than oil.

Farm Tractors.—On the really big farms of the West, those of 1,000 acres and upwards, the horse has practically disappeared, and the internal combustion motor, in some form, has taken its place for every kind of work, also for milking the cow and pumping the water to the wonderful traveling factories that reap, thresh and sack the grain in one continuous operation. The reason for this is quite evident, for the engine can work at full power through the entire 24 hours of the day if necessary, day in and day out; it works at a much greater speed and costs less to keep than a nominally equivalent number of horses, besides requiring, in the larger powers especially, a much smaller number of men for its operation. Although steam tractors have been successfully used for many years the development of the internal combustion machine has been unaccountably slow, and it is only within a comparatively recent period that really good tractors of this type have been available, and these are mostly of the larger sizes. It has, however, apparently required the necessities of the war to arouse both the manufacturer and the farmer to the possibilities of a small tractor that can be used on farms of small size, and, unfortunately, there are many newcomers in this field who are possessed with the idea that passenger automobile practice can be readily applied to this new, and absolutely different service. A good farm tractor cannot be built on theory, nor from the experience of a single day on the farm.



Writing-tools for the blind: Fig. 5 shows the Braille typewriter; Fig. 6 the Braille "slate" in operation, and Fig. 7 the slate opened to show its construction, with the writing implement beside it

For Those Who See with Their Fingers

How Books for the Blind are Manufactured, and What They Mean to Their Readers

ONE of the most delicate portions of the human anatomy is the eye. A blow which in any other place would at most produce but a temporarily painful bruise will completely rupture the tender membranes of the visual organ, so that function is permanently lost. A foreign substance which would hardly penetrate the skin at all, or which after penetration could be extracted or allowed to remain without difficulty or danger, will destroy the eye beyond repair. And the connection between the eyes is so intimate that when one is attacked by violence or disease, the other is more often than not affected sympathetically.

All this has direct bearing upon the hazards of war. Battles are waged and lines held amid an incessant hell of flying metal, gas and flame. The mathematical probability of a man thus exposed receiving a blinding wound is incomparably greater than that attaching to the most reckless Fourth-of-July celebration or the most hazardous industrial occupation. To be sure, the gas threat, by forcing the use of masks, actually cuts down to some extent the total of eye wounds. But in spite of this factor, experience confirms reason in telling us that the war is going to give us a blind population vastly outnumbering anything of the sort for which the race has ever before had to provide.

Fortunately the number of persons in civil life blind congenitally, from accident or from disease, has been sufficiently large to justify and to insure a steady though slow development of means for relieving the sightless of part of their burden. Especially must we recognize the place held by improved avenues of communication between the external world of light and the blind. We who read freely seldom give thought to the great reliance which we place in the written and printed page for our contact with the world. But if we pause to do this, we realize that in being robbed of the ability to read, the sightless man is at once deprived of his greatest line of communication. With newspapers, magazines and books denied him, with loss of the power to appreciate form and size, distance and direction, save by the coarser contact of touch and sound, the blind man lives indeed in an isolated world. One is more often alone than one realizes; when one is not alone, the possibility of being read to or talked to is often absent. The invention of the written word placed in the hands of man a means of passing on his thoughts and deeds to others which far transcends anything he could otherwise possess, and which actually forms the basis of our civilization. To a person educated in accordance with the demands of that civilization, it is stark tragedy to be reduced to the spoken word as a means of contact with the world.

It was to meet this condition that the Braille script was invented. Everybody knows in a general way that this affords the blind man a means of reading with the finger-tips. At the risk of being encyclopedic, we are going to assume that most of our readers do not know very much more than this about it, and will explain the Braille system and its application, from the ground up.

If the reader will put down on paper a rectangular array of dots, two horizontally and three vertically, like the six-spot on a domino or a die, he will have the foundation of the system. If he will then imagine each dot raised about a sixty-fourth of an inch above the general level of the paper, he will appreciate that with a little practice he could tell, by feeling with his finger-tips, whether they were all there or whether some of them were missing.

These dots are the elements from which the Braille alphabet is built. By leaving out one or more of them, a total of 63 different combinations could be made. Since this is more than we need, we can eliminate those combinations which would not be readily distinguishable. It is a matter of no difficulty to find twenty-odd arrangements which shall be easily identifiable to the touch; and these may represent the letters and the leading punctuation marks. Further, while it is only in combinations that the dots possess meaning, they have to be impressed separately by the writer and detected separately by the reader; so an effort is made to consider the accepted frequency values of the letters. Thus, in the American Braille, a and e are represented each by a single dot; i, o, r, s, t and the period by two dots; b, c, d, f, h, l, m, n, p, u and y by three dots; g, h, v and w by four; while only q, x and z require as many as five.

The ordinary written or printed alphabet presents no mechanical difficulty, since anything hard enough to scratch or soft enough to leave a trail will make a legible mark. But the Braille alphabet calls for clean-cut, round dots, raised from the sheet. Of course we will impress them from the wrong side; but we must then learn to write in looking-glass fashion, from right to left, while we still read from left to right.

For writing Braille by hand, the so-called slate which we illustrate is furnished in a variety of sizes. The back-piece is solid, covered with depressed "six-spots" at regular intervals. The front-piece is hinged at the edge, so that the apparatus can be opened for the insertion of card or paper, and closed again on the sheet. It is also pierced with little rectangular windows, one opposite each "six spot"; the sides of these are not straight, but each presents three little jogs. The tool consists of a metal rod or wire, on a wooden handle. When this is fitted against one of the little jogs and pushed down sharply, its round, blunt end enters the corresponding depression in the back-piece. With the paper between the two, a Braille character is impressed, head down, as the result of this operation

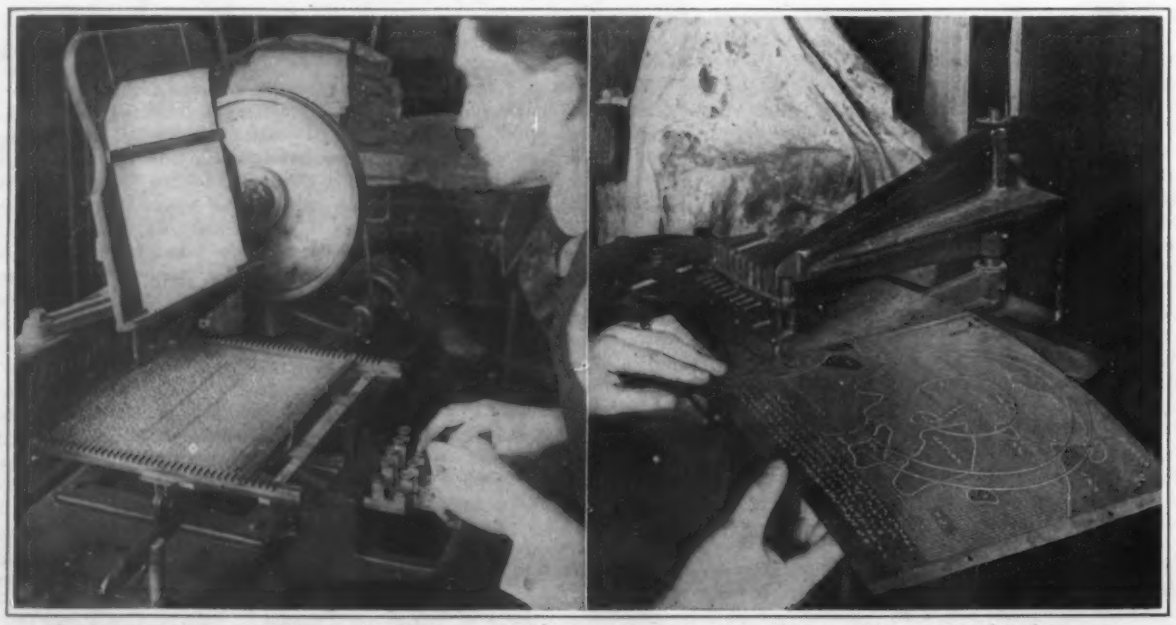
With the aid of these slates two blind persons can correspond, or letters can pass between a blind man and a seeing friend. It is not even necessary for the latter to go through a special course of training; cards bearing the Braille alphabet are to be had, and the seeing man can search out the letters and copy them off on his slate, gaining speed with experience, much like a man teaching himself to use the typewriter.

But any system requiring from one to five movements for each letter—and movements which must succeed one another, which cannot be made simultaneously—is on its face not the last word. The answer to this suggestion might seem to be a typewriter with the ordinary universal keyboard, but carrying punches for the Braille characters instead of the ordinary type. The objection to this is that not all blind men can learn to strike accurately on a keyboard of 26 or more positions, and that the typewriter must be for the use of all.

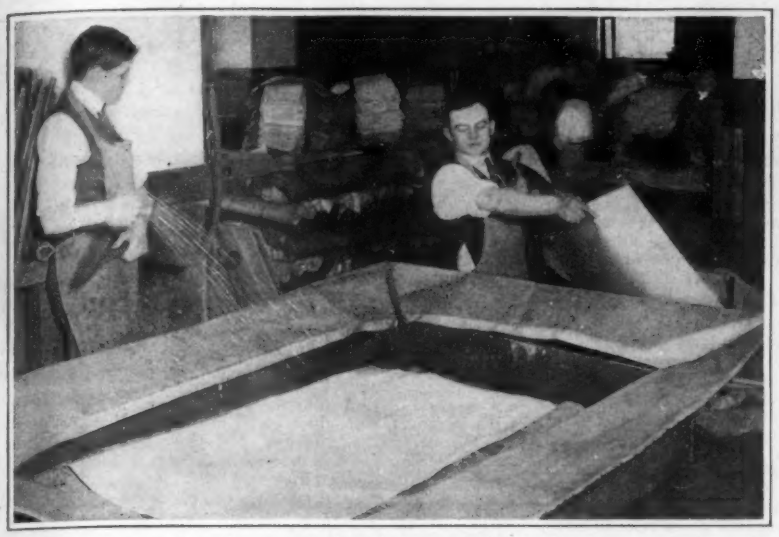
So the Braille typewriter, as developed commercially, goes right back to the fundamental six dots. It accordingly requires but six keys, each corresponding to one of the six positions, and impressing a dot in that position. A letter is struck by striking the keys which it calls for, not one at a time, but simultaneously, as a musician strikes a chord. The keys stand in a single row, with considerable room between them, three on each side of the space-key in the center. The clumsiest person can learn to operate this machine with accuracy, identifying each key with a certain finger; and excellent speed is attainable. Indeed, to say that the blind typewriter is materially slower than the ordinary key-pounder would be like claiming that the skilled musician strikes chords more slowly than single notes.

Even this does not exhaust the possibilities for giving the blind intellectual contact with the world; machinery has been developed for printing the Braille characters, much as ordinary type-set matter is printed. The procedures are of interest, if only in comparison with those of the ordinary printery. It has even been found possible to print on both sides. Considerable space must be left between lines anyway, to prevent the sightless fingers from getting on the wrong track. It turns out then that a hole is much harder to feel than a bump; so the presence, in this interlinear space, of depressions corresponding to raised characters on the reverse of the sheet, does not confuse the reader in the least.

The printing, of course, is done from plates. These are not cast from a paper matrix, as one might expect, but are punched out, by machine, in the sheet of copper. The keyboard is like that of the typewriter; the impressing is done by means of a male punch which attacks the sheet from behind, and a female companion which meets it from



In the composing room of the blind print-shop. At the left, setting text; at the right, punching out the plate for a map showing the operations of the Stefansson Arctic expedition



At the left, wetting the paper before "printing" the Braille characters on it. At the right, gathering the sheets of the monthly magazine for the blind. All these girls are blind; the one at the extreme left is also deaf, and her fellows talk to her by "writing" on her palm with their finger tips

in front. The operator thus proceeds from left to right, and the characters are raised on the side of the plate facing him. The plate, unlike the one used in ordinary printing, is then a positive, and proof can be read direct from it, without the need for trial impressions. When mistakes are discovered, they are pounded out with a hammer, and the correct characters re-impressed in their place a dot at a time with a hand punch.

The plate is bent about the cylinder of the press, raised side up; as the sheet passes over it, the characters are impressed on the back of the page, and thus raised on the obverse. Two-sided printing is done from opposed rollers at a single operation. The paper is of a peculiar brownish-gray tint, hard and tough; and to prevent the type from cutting through, it goes on the press only after a careful and comprehensive moistening.

The work of composition is done from ordinary copy, and so calls for a seeing operator. Proof-reading may be done by a blind reader; but where the sightless workers predominate is in the bindery. The piles of sheets are laid out in order on the gathering table by a seeing operator, and gathered entirely by girls who are without sight, and sometimes without hearing as well. As they reach the end of the table with the completed volumes, they come to a rack consisting of four thin upright posts. They give a dexterous sweep of the hand to see which way the last volume deposited lies, and place theirs across the other way. Then when the seeing checker runs over the pile, she has each volume conveniently separated from the ones above and below.

The possibilities of illustrating the text are not large, but they exist. In particular, it is feasible to present good maps. The plates for these are made on a special machine which has a number of punches, each carrying its peculiar die. There are the circular arc for representing mountains, long and short straight lines and curves for the outlines, a block of four dots to indicate water, a solid circle and a ring for cities, etc. The plate is not anchored to this machine, but is manipulated freely by the hand, so that any mark can be impressed on it in any position and lying in any direction.

The bearing which all this has upon the blinded soldier is obvious. Like all the war's maimed, he must be restored to the estate of a useful citizen. The very first step consists in learning the Braille alphabet and training his fingers to read it. When he has done this, he is again in intellectual contact with the world. He is now convinced that he is still of the world as well as in it; and with the despair bred by fear eliminated, he is ready to learn his new occupation. With a means of occupying his mind when he is not working, he can attack work with a will.

The Lighthouse, New York's organization of help and hope for the blind, has for some years been engaged in a studied effort to enlarge the field open to blind workers. The possibilities of hand and machine knitting and weaving, alike in cloth and in cane, have been pushed to their ultimate limits, far beyond their previous bounds. Pottery has been added as another simple manual art which the blind can execute particularly well; and it has been found that men without sight are peculiarly adapted to massage work. Blind men with playing or singing talent are encouraged to develop these abilities, music being printed in raised characters for their use. Small telephone switchboards in which each line can be equipped with a buzzer of distinctive sound are operated as efficiently by blind as by seeing workers. A stenographic machine for taking down dictation has been invented, on which the best operators have developed ordinary stenographic speed; while dictation through the phonograph is admirably suited to the blind typist.

We have referred to the difficulty of operation of an ordinary typewriter by the blind. It cannot be denied that this difficulty exists; and it is enhanced and made into a mental hazard by the fact that after he has made a misprint, the blind typist has no means to correct it, since he cannot see to direct the eraser. But this difficulty is not an insuperable one. It is met by so regulating the speed and so intensifying the training that the blind typist makes the minimum of mistakes consistent with human fallibility; and blind typists are freely employed, especially in France, where this work is preferred above all other for sightless soldiers who can qualify. The blind typist works on a page bearing at its foot the printed statement that the letter has been typed by a sightless operator. For advertising reasons, a hard and fast rule is enforced that no letter shall go out bearing visible marks of erasure; and this is not found at all unworkable.

In the very well worked out French reclamation service for the blind, the general idea is to give each man the most intellectual work for which he can fit himself. The blinded soldiers may study anything in the world, from higher mathematics down; a very notable proportion elect languages. As evidence of their successful reëducation, we are told that one has become a Director of Studies in the Military College; that a former school teacher has resumed his classes; that a student has taken his Degree in Philosophy; that one blinded soldier is Inspector for the Board of Education, and another a professor in a government school. A one-armed blind man is giving instruction to 20 seeing men in a technical school, Many others, somewhat less brilliant, have found employment as typists, telephonists, secretaries, etc.; and the non-intellectual classes have been no less successful in returning to occupations quite on a level with those which they formerly pursued. But in every case, successful initiation into the new work and contented pursuit of it depend wholly upon the ability to get and to read books printed in Braille. In this connection, we direct attention to the appeal on our Editorial page.

A blind person reading the Braille magazine. The reading is done with one hand, while the other marks the beginning of the next line, so that the sightless fingers will not skip or repeat a line

No More Punctures for Sweden's Cyclists

RUSTY nails, broken glass, and other obstacles to the navigation of bicycles with pneumatic tires will no longer annoy riders if a new Swedish invention proves practical and comes into wide use. This arose from the scarcity of rubber, which made it necessary for a cyclist to buy a new machine in order to obtain a pair of tires. It is about as easy to import rubber into the Scandinavian countries these days as it is to find a picture of the Kaiser in the White House, and accordingly substitutes have been sought. A thin strip of hardened steel, resting on springs fastened into the rim of the wheel, is said to give an elasticity quite comparable with that of the rubber tire. The sharp edges of the steel tire prevent skidding, and its durability, of course, is far greater. Selling at about four dollars, the new tire will be cheap on account of the saving of expenses connected with punctures. It is reported that a similar article is being used in Germany and was displayed at the Leipzig fair last spring. Whether the same principle may be applied to automobile tires is a question on account of the severe strain that the weight of the car would impose upon the springs.

During a demonstration at the Swedish Automobile Club at Stockholm the new bicycle tire proved to be so adaptable and simple that surprise was expressed that it had not been thought of long ago. It is hardly likely, however, that the steel wire will displace the pneumatic permanently, for after the war the latter will be sold at lower prices and in spite of its weakness for stray hardware along the highway it makes riding easier.

For Better Thrashing

WASTE of grain at thrashing time is carefully watched in Oklahoma, at least, and reported for action to the head of the Food Administration's thrashing division. Where the machine is at fault its withdrawal from the field is at once ordered; and in the event that the blame lies with the crew the attitude is taken that there are plenty of careful and competent threshermen to be had, without retaining those who are deliberately, or otherwise, aids to the foe.

In one case a careful crew followed a careless one, and thrashed 65 bushels of grain out of the straw stack left by the first machine. There is a thrashing committee organized in all the important wheat counties to see that machines do the right kind of work, and to look after the repair of bad apparatus or the discharge of bad operators. Farmers are urged to report to such committees; if they fail thus to get satisfaction, they should wire the Federal Food Administrator of the state whenever they find careless thrashing going on. It is not the intention of the Government that the efforts of loyal farmers to increase their output shall be discounted in any such way as this.

A Model Shipworkers' Town

PLANS for the construction of a model shipworkers' town to be located near Camden, N. J., have been completed by the housing division of the Emergency Fleet Corporation. The work of clearing away the site is now well under way, and the homes are to be ready for occupancy within a few months' time.

Approximately 3,000 workers for the New York Shipbuilding Company will be provided for in the new community which will be known as Haddon Township. There will be 907 houses, mostly brick, detached and in rows, costing on an average $3,070.

The contracts for the construction of the shipworkers' town have been placed with a large contractor, while another contractor is to make the streets. The houses will cost between $2,000,000 and $2,500,000. The cost of laying out the site with street improvements, parks, playgrounds, and other up-to-date features of town planning will approximate $325,000. The city of Camden, with which the new town will be incorporated, is ready to spend $325,000 in building schoolhouses, fire stations, sewerage and water plants.

An extension of the existing electrical lines to the shipworkers' community will be undertaken by the Emergency Fleet Corporation at a cost of $125,000.

A realty company, subsidiary to the Emergency Fleet Corporation, will rent or sell the houses to the employees. Rental and selling values will conform with the prevailing rates. The housing commission expects the investment will pay for itself within a few years.

Gas-Proof Food Containers for Men in Gassed Regions

THE Quartermaster's Department is now supplying gas-proof food containers to the soldiers in the zone of operations in France. These containers prevent seepage of gas into the containers and guard against contamination of the food.

The men carry their emergency rations in the containers, and all food brought up to the trenches is carried in the new tins.

After the food is packed in the containers they are hermetically sealed. It is planned to use paraffin for sealing, as it settles in the crevices in such a way that it must be cut before the lids can be taken off. It can be applied by running the containers through a paraffin bath. Realizing that the supply of tin is limited and that there may not be enough to supply the needs of the Army as rapidly as it is needed, the Quartermaster's Department is experimenting with the waxpaper box. Tests made show that these boxes meet all conditions satisfactorily. The tin and boxes are both vermin and water proof.

The Service of the Chemist

A Department Devoted to Progress in the Field of Applied Chemistry

Conducted by H. E. HOWE, Chemical Engineer

Gas in Warfare

WE are familiar with the saying that history repeats itself and facts seem to justify the phrase. Fortunately the cycle for some things is very long and one of these is gas warfare. In the progress of civilization an attempt has been made to reduce the horrors of war and develop rules which would at least give opponents a fair chance for their lives and an opportunity to fight in manly fashion. Because gas does not do this it was agreed at the first Hague convention that it should not be used, but with the German reversion to the brutal characteristics of savage ancestors they had no hesitancy in introducing gas.

Prior to the attack at Ypres, on April 22, 1915, gas had not been used since the fourteenth century. Before that the Saracens used fire and obnoxious gases against the Crusaders about 1073 A. D., there is the record of "Greek fire" in 673 A. D. and between 431 and 404 B. C., the Spartans attacked the Athenians with sulphur dioxide produced by burning wood saturated with pitch and sulphur. They went so far as to use large bellows to blow the fumes over the enemy lines, a refinement not practical under modern conditions.

Besides killing men gas serves greatly to reduce the efficiency of an army by causing it to work in gas masks, tends to create confusion in ranks and transport, and makes ground untenable under certain conditions. Many gases have been used and developments make it possible to apply all organic chemistry to this problem. As in all military tactics there is offense and defence, the problems in each case being highly specialized and quite different. The ideal of gas offense is a colorless, odorless, invisible, tasteless, highly toxic gas capable of being made in large quantities, of being easily compressed for transportation, having a high specific gravity, slow to react with chemicals, and offering the possibility of high concentration in the enemy's lines.

Gas defence strives to provide perfect protection against such gas for men, horses, dogs, carrier pigeons, and any other animal life excepting rats and cooties. Space and weight impose limitations and it has been said that whichever side forces the other to carry oxygen tanks for protection will have won an advantage that will mean victory.

Chlorine Gas

The first gas used was chlorine and its greatest usefulness besides toxicity was in the complete surprise of the attack which found the British and Canadians absolutely unprepared. Pure chlorine reacts very quickly with a number of substances and those who had the presence of mind to bury their faces in earth or even to wrap their faces in their mufflers escaped. Had the Germans realized the success of that first attack they might have won the war then. That attack was a cloud of gas obtained by opening steel cylinders holding 40 lbs. of liquid gas placed one to a yard and allowing the contents to flow through lead pipes. The wind did the rest. The difficulty of attacking with any gas lies in the necessity of coördinating favorable meteorological conditions, gas concentration, surprise tactics and large supplies. The wind must not be more than twelve miles per hour and in the right direction, without upward currents. The land should slope toward the enemy or at least be level. Gas must be liberated rapidly enough to give as high a concentration as possible and not less than 1 part in 10,000. This means transporting 100 tons of material for each mile of front to be attacked and the effort is wasted should the wind suddenly change or the enemy be amply protected with efficient masks. Surprise tactics include the use of successive clouds, of unusually high concentrations for long periods, mixing with smoke and use in light so faint as to render visual detection difficult.

Phosgene Gas

Chlorine was soon displaced by phosgene which is much more toxic even than hydrocyanic acid gas. It is not related to phosphorus but has the formula $COCl_2$ and is known in chemistry as carbonyl chloride. It is more difficult to neutralize than chlorine but the problem of defence was soon solved and while cloud attacks have not been abandoned, little has been done toward introducing new gases for the purpose. A cloud offensive is open to several objections the most serious of which are the enormous preparation required, the necessity of having specially trained men to handle the gas, the exacting conditions for a successful attack and particularly the fact that the highest concentration of gas is near the trench where it is being liberated and not in the trenches of the enemy.

Gas Shells

We come then to gas shells which is equivalent to carrying the cylinder of liquid gas to the enemy and opening it there. The use of a shell opens up all that organic chemistry can provide and makes gas warfare somewhat more simple as regards offense. Gas shells carry solids or liquids, which vaporize or become scattered in fine particles when the shell explodes. They may be mixed in with high explosives, shrapnel and other shells, they may be placed upon army target with accuracy and fired from the usual guns by the usual gun crew. Targets beyond any gas cloud may also be reached.

Gas used in shells may be classified as toxic or very injurious, harrassing and those designed to render the territory untenable or combinations of these. Those which harass or annoy without doing worse include gases causing sneezing and subsequent removal of the mask so that toxic gases present may be given an opportunity to kill and the lachrymators which produce tears in sufficient quantity to blind temporarily. When a man is constantly sneezing or blinded by tears it is much easier to catch him unawares with gas and shell. The first tear shells were xylyl bromide or benzyl bromide and of these so little as one part in a million is enough to make the eyes run with water, while these substances may continue to evaporate for days and cause annoyance over a wide area.

Mustard Gas

Dichloro-diethylsulfide is the correct name for mustard gas so called probably because of its odor which, however, is said to be more like garlic. The Germans term it yellow cross gas because all cylinders and shells containing it bear a yellow cross. Mustard gas is relied upon to render ground uninhabitable and it is particularly effective. Its effect upon the eyes is sometimes slow in manifesting itself but within a few hours blistering occurs while the membranes of the nostrils and throat are severely affected. The gas volatilizes slowly and the vapor has the power to penetrate cloth and even leather. Contact with the spray or droplets gives rise to very severe blistering and deep burns which are slow to heal. In one instance a soldier who had walked through grass upon which some mustard gas was present was badly blistered on feet and ankles through heavy shoes and leggings. In removing his shoes and clothing his hands were blistered all over and the body was also blistered wherever his hands touched it.

In order to provide protection it is necessary to know what the gas is and its reactions with chemicals which may be used in masks. Advance information of the enemy's intentions is secured at times and the samples of these gases are obtained in various ways such as in trench raids and unexploded shells. Vacuum tubes are also employed. These tubes of various sizes are so made that an end can be broken off, whereupon the air carrying the gas rushes in and is then held by sealing the tube with a cap. It then becomes the chemists task to identify the gas in the laboratory and devise ways to neutralize it. A reactive gas like chlorine is easier to stop than phosgene which is less reactive and there are other gases still more difficult to overcome because they unite with chemical reagents very slowly or not at all under normal conditions.

Gas Masks

The first masks were but small pads hurriedly prepared and treated with sodium carbonate, by the women of England. But they would not stop phosgene. Sodium phenate does and the hood-like masks with mica windows which were evolved were treated with phenate. As in all offense there is the constant effort on the part of each to overcome the other and the element of surprise is very important. The first gas attacks had been with a low concentration of gas and the next step in offense was to increase the concentration beyond what the masks would stand. Sodium phenate needed reinforcement very soon and hexamethylenetetramine was suggested after many researches. The combination will give protection against one part of phosgene in one thousand parts of air for a long time. The earlier attacks were one part of gas in ten thousand.

We have seen how developments in offensive forced the use of two chemicals in the cloth hood and it is obvious that the possibilities in treating fabric must soon become exhausted. The gas mask has naturally passed through many stages and a host of ideas have been given trial. Structural and mechanical problems as well as chemical ones have presented themselves and even psychologists have contributed to the solution. The question of windows in masks is important. Glass breaks, celluloid is inflammable and cellulose acetate has a low visibility besides being relatively easy to abrade. A window has been devised that has none of these objections.

The metal box or cannister type of filter soon appeared. This is a filter in which various chemicals may be placed in the best order for results and the air drawn through them. Active absorbent charcoal is found in practically all masks along with alkaline permanganate or some efficient oxidizing agent. According to Major Auld, the German masks contain a layer of pumice with hexamethylenetetramine, charcoal and baked earth saturated with potassium carbonate solution and coated with finely powdered charcoal. In all such filters due consideration must be given to maximum protection without too much interference with breathing, for suffocation is a danger. The fabric forming the mask, the fitting to the face, the tube leading to the filter, the seams and necessary points of attachment, all present problems that have not been easily solved. New methods of offense constantly introduce new phases and research is required to learn what it is that must be met. Gases, solids and liquids each call for special treatment and masks alone afford no protection against such gases as mustard. There the body must be covered with substances, such as certain oils, which the vapor can not penetrate and special precaution must be taken to cover the more tender portions of flesh as for example under the arms.

Efficiency of Different Gases

In rating the efficiency of gases it is customary to record the minimum efficient concentration, which is the amount required to produce a casualty in five minutes, and the maximum bearable concentration or the amount that can be breathed for one hour without serious injury. Both these factors are without reference to mask protection. For the more familiar gases these figures are about as follows:

Gas	Minimum Efficiency Concentration	Maximum Bearable Concentration
Sulphur Dioxide	0.05	0.005
Hydrogen Sulphide	0.10	0.010
Carbon Monoxide	0.50	0.100
Chlorine	0.01	0.005
Phosgene	0.02	0.005

When phosgene is present in less than 0.005 it has a serious effect upon the heart although this may not manifest itself for a number of hours. Such values as are given above are determined first upon small animals and if promising results are obtained the next subjects for experiment are the enemy. There are a number of preliminary tests for the efficiency of protective measures but the final test must obviously be with men selected for the purpose. Such men are seldom mentioned in dispatches but they take their lives in their hands almost daily that the protection for their fellows may be made one hundred per cent perfect.

One need but consider the extent of organic chemistry with its rings, side chains and multiple rings to realize what opportunities the gas shell presents. No records are available as to the list of compounds which has been used, but in the Journal of the Washington Academy of Sciences, Major Auld of the British Military Mission gives the following as having been used by the Germans in gas clouds or in shells:

Name	Use
Ally-iso-thiocyanate	Shell
Benzyl bromide	Shell
Bromo-acetone	Hand grenades
Bromated methyl-ethyl-ketone	Shell
Dibromo-ketone	Shell
Bromine	Hand grenades
Chloro-acetone	Hand grenades
Chlorine	Cloud
Chloromethyl-chloroformate	Shell
Nitro-trichloro-methane	Shell
Chlorosulfonic acid	Hand grenades and "Smoke Pots"
Dichloro-diethylsulfide	Shell
Dimethyl sulfate	Hand grenades
Diphenyl-chloro-arsine	Shell
Dichlormethyl ether	Shell
Methyl-chlorosulfonate	Hand grenades
Phenyl-carbylamine chloride	Shell
Phosgene (carbonyl chloride)	Cloud and shell
Sulfur trioxide	Hand grenades and shell
Trichloromethyl-chloroformate	Shell
Xylyl bromide	Shell

For obvious reasons any discussion of things military must be confined to those that are so old as to have no importance now. The work of the enemy we may talk about but must wait before the accomplishments of the Allies may be listed. We may be confident that the devil will be fought with fire hotter than any he has used and be made to regret the day the world was challenged by gas. Notwithstanding increased concentration and toxicity in gases, the extravagant use of gas shells holding about six pounds of liquid gas and reaching 50,000, upon one small town in a single night, and the effectiveness of gas shells even where high explosives fail, the chemist has done wonders in reducing the numbers of casualties and continues this good work. Another group works unheard of hours, amid danger and under great pressure to score in offense and it may easily be that the war in the last analysis is being fought out in the chemical laboratory.

Replacing Silk with Cotton in Gun-Powder Bags

CHEMICALLY treated cotton cloth, as a substitute for silk, is being tested out by the Ordnance Department.

If found practicable for ordnance uses, the discovery will effect the double result of meeting a serious shortage in silk, and of bringing about a money saving in the ordnance program estimated at between $25,000,000 and $35,000,000.

Preliminary tests already made at the Aberdeen Proving Grounds have encouraged the department to proceed further with its experiments, and for this purpose an order for 5,000 yards of the new material has been placed with the concern responsible for developing the process of treating the cotton cloth.

At present millions of yards of silk are required in making the bags which contain the large powder charges used in the firing of heavy artillery. These bags are inserted in the gun immediately behind the projectile, and the firing of them gives the propelling force that hurls the projectile at the target. This propelling charge is, of course, entirely distinct from the charge within the projectile that explodes the missile after it reaches the target.

Heretofore, silk has been depended upon for these bags for the reason that no other cloth material has been found that would meet the peculiar conditions required. It is essential that not a particle of the bag container shall remain after the gun is fired. Otherwise a smouldering piece of the fabric might cause a premature explosion when a new charge is inserted.

Owing to the great scarcity of silk, however, the cost of this material has increased enormously. This shortage is felt by all the warring powers, including Germany. Early in the war Germany is understood to have used a chemically treated cotton as a substitute for silk, but has since been compelled by the diminishing cotton supply to resort to other substitutes. It is estimated that the chemically treated cotton now being tried out by the Ordnance Department, if entirely suitable, could be purchased in almost unlimited quantities and at a cost far below that of the silk fabric now used.

Savings by Retrieving Empty Packing Cases

ONE of the big British companies manufacturing packed foodstuffs has hit upon an admirable scheme for retrieving its empties and saving its timber reserves. It made it known among its customers that it wanted its cases back regularly and promptly, and that if there was any difference between the estimated value of old cases returned and the cost of replacing them with new ones the company was prepared to hand over what was saved to the British Red Cross Society. The result of the first quarter's working of the scheme has been no less a sum than $4,700, a check for which has been sent in the name of "The Grocers of the United Kingdom." A further appeal is now made to all the company's customers.

The New Cycle in Industrial Organization

A Study of Leadership as It Bears Upon Human Relations

By Mark M. Jones, Supervisor of Personnel for the Thomas A. Edison Industries

THESE are truly cyclic times of high frequency alternations. We move through one cycle in our development and approach another almost before we know it. The rate of acceleration of our work more or less determines the day when we reach the new cycle.

The cycle upon which we are now entering is that of a more scientific study of leadership as it bears upon human relations. We have already taken the initial step and are passing from days of passive to days of active interest in questions affecting the human element in business. We are moving from days when leadership has been satisfied with conditions surrounding the manpower of an enterprise which are now coming to be regarded more or less as examples of the lack of proper organization.

We are starting upon an era in which we will substitute comprehensive standards governing the administration of human relations for the individual standards that have been applied by the "firing line" executives in the enterprise of average size. If in such a business we analyze the situation as it was a short time ago in some cases and still is in others, will we not find that leadership, in its attention to more tangible things, has tolerated, with respect to the human side of the enterprise, the following conditions?

(1) Lack of specialized administrative machinery for the application of a uniform labor policy.

(2) Autocratic direction of functions by individual executives.

(3) Financial exploitation of workers by foremen, superintendents, or more intelligent co-workers.

(4) Disregard for the health and safety of workers.

(5) Passive interest in the question of adequacy of compensation.

What these conditions really amount to can be appreciated by an outline of the organization properly applicable as a corrective measure.

The Department of Human Relations

To meet the first condition many enterprises have now established a Personnel, Employment, Labor or Industrial Relations Department, which is charged with the responsibility of applying a uniform labor policy insofar as the management has seen fit to concentrate that responsibility in this particular department. This means that the scope of its activities varies with the enterprise. In one plant the Personnel Department is simply responsible for employment. In another it is responsible for employment and betterment work. Beyond this the scope might be widened still further to comphrehend safety work and hospital service. To this might be added control of rates of pay and beyond this the representation of the management at the growing number of meetings with workers or governmental agencies on working conditions and rates of pay.

IN a previous discussion of industrial conditions, contributed by Mr. Jones to our issue of August 24th, we stated in an editorial note that he was in charge of the personnel work of a group of industries employing 15,000 workers. We took this statement from what appeared to be an authoritative source; but we have since learned that the correct figure is 8,500. While we gladly avail ourselves of this opportunity to correct our error, we are sure our readers will agree that even with its reduced size, the army of workers under Mr. Jones' care is sufficiently large to qualify him to speak with authority upon questions of employment organization.—THE EDITOR.

Building up an organization of this type should bring order out of chaos. It should quickly start an entire enterprise on a new tack toward better days. It should provide the figures on matters affecting human activities that are generally lacking in business and that mean so much as a guide to the future. It should bring a change from the day when labor turnover is not understood as a term, and make it an every day working tool of those in executive positions. To outline the shortcomings of any one industry in this respect would be to outline those of the majority, and I am, therefore, not selecting any particular enterprise but am referring to a composite instead.

The lack of specialized administrative machinery of this sort usually indicates that in the first place an Employment Office of the right type has been lacking. In most cases no Employment Office has existed at all. In other cases a clerk has simply been in charge for the purpose of acting as a messenger for a foreman or the other executives who pass upon the qualifications of applicants. The result has been that if the enterprise was operated by 50 foremen there were 50 different people handling the employment and 50 different standards of judgment were applied to men. It was not unusual for two or three departments to be seeking the same kind of a specialist when that specialist was applying to other departments and being rejected because the need for him at that point was non-existent.

The human tide flowed in and out of the plant without any regulation or restriction whatever. And as a usual thing the flow has been heavy—just how heavy could not be stated in many cases. A properly organized Employment Office must usually be established before labor turnover can be ascertained; although in other cases analysis of the payroll gives partially satisfactory results. Thus some study has been directed toward the cost of this unrestricted ebb and flow of the human tide.

Lack of a central clearing house for labor matters has in many cases permitted the operation of departments by individual executives on an absolutely autocratic basis. The foremen who handled a force of 50 men might come to work on Monday morning with a slight "hangover" from his week-end and dismiss the best 10 workmen just to relieve his feelings. After the fact he was frequently compelled to find a good reason for having done so; and being human he had little difficulty in this, because no one had more than a superficial interest in the matter.

Each executive has had his own ideas of what should result in dismissal. In some cases where men did not happen to be on the best of terms with their boss, they have been discharged for being two minutes late, when the fault was entirely a matter of street car service; while in other cases repeated violations of plant regulations would take place without action. Each executive ruled his own department on an autocratic basis, and was allowed such latitude in his hiring and firing that a considerable shock has resulted and is resulting whenever an agency for scrutinizing such matters in an impartial way is established. The individual worker generally judges the firm by his own experience and from his standpoint the particular foreman he works for is the firm. His judgment of the enterprise, therefore, rises or falls as the treatment he receives at the hands of his boss is good or bad.

The Price of a Job

Financial exploitation is an evil that is fast disappearing although it still exists in enterprises under poor management. It has not been infrequent for men to pay from one to ten dollars or even more for their jobs. Originally when the foreman hired and there was an excess in the supply of labor, men frequently paid him a substantial sum of money for the privilege of getting a place to work. It often did not stop at that point; later on they were compelled to pay again and again for the opportunity to hold the position. In other cases the labor turnover of the job had been greatly increased by the unrestricted dismissals of men who had worked a few days. Investigation would have shown that the foreman was receiving from one to four dollars for each man employed and that it was necessary to dismiss a certain number in order that a large enough group of new workers could be engaged to produce the amount of revenue that he thought necessary at the time. For foremen or superintendents thus to make from five hundred to one thousand dollars per month, and even more, was not an extraordinary matter. Installation of administrative machinery for scrutinizing all such activities has had a wholesome effect and great progress has been made toward stamping out such evils entirely.

(Concluded on page 236)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Who Shall Eat the Bran?

To the Editor of the SCIENTIFIC AMERICAN:

In the SCIENTIFIC AMERICAN of August 10th, 1918, under the title, "What Shall We Do with Wheat Bran?" Mr. A. D. Holmes presents a line of argument to which I must take exception, as it seems to me not only misleading, but fallacious and dangerous to the best interests of the nation.

I believe his first fundamental error is the assumption that man was designed by nature to be in part a flesh eater. Here, however, the objection will be raised that the question of vegetarianism versus meat eating in toto is not the point at issue. This I admit, and will try to confine myself to the problem as to whether it is ever economically profitable for the entire community to feed potential human food to animals with the expectation of recovering a part of the human food from the carcass of the animal, taking also into account the problem of soil fertility.

I concede that the process may yield a *temporary* financial profit to the stockman, and I speak as a farmer who has raised some live stock. I say, "*temporary* profit," because in spite of the timeworn theory that live stock is necessary to maintain soil fertility I think there is grave doubt as to the fundamental accuracy of this doctrine when all factors are considered, at least under any method of management at present practised.

The next two basic errors I believe are found in the following sentence: "If the present food habits of the American people may be considered a safe guide, it would appear that the ordinary American mixed diet, containing fairly liberal amounts of meat and milk, furnishes sufficient ash or mineral matter to meet the body's requirements. In such a case the excess mineral constituents merely place an added burden on the excretory organs of the body."

The first, and most grotesquely erroneous assumption here is that the food habits of the American people can be taken as a safe guide. Safety in guidance depends upon the results produced by the guiding principle. When we look at the toothless, bald-headed, deaf, bespectacled mortals around us, lacking any acuteness of taste and smell, and burdened with physical and mental ailments, can we believe that the results justify confidence in the habits which produce them? It will here be argued that we have other bad habits than faulty diet, and so we have, but incorrect food is responsible to no small degree for the burdens we have placed on our own shoulders.

The second misconception in the above quoted sentence is that undigested portions of food are a burden to the system. This would be true in the case of *unnatural* food, especially if taken in excess, but would not be true when only *normal* amounts of natural food are eaten.

In fact, Mr. Holmes seems to have overlooked the beneficient mechanical effect of this undigested portion of normal food in facilitating peristaltic action and in serving as a soft brush to sweep out the digestive tract. He also appears unconscious of the fact that the vitamines and ferments now known to be so vital to our well-being are found in the bran and outer coatings of the wheat berry, and not in its interior.

When we compare the physical condition of wild (not domesticated) animals with that of civilized (?) man some points stand out with startling distinctness. The wild animal is guided wisely and unerringly to his proper food, and he is never sick, nor does he have to maintain insane asylums!

You cannot fool a potato bug into the belief that a maple leaf or a strawberry is suitable food for him. He will go incredible distances to find a potato plant, but if this be impossible he will, under continuous protest, turn to the most closely allied plant available, as a tomato or an eggplant. There is little doubt, none in my mind, that man originally had senses as acute as those of the wild creatures, and an instinct which guided him unfailingly to the fruits, nuts and grains which were his proper foods, and which he ate usually with their skins, seeds, hulls, and bran. These coarse and partly indigestible materials he was fitted to handle and to turn to good account.

There came a time, however, perhaps because of a changing environment, or the discovery of his power to choose, or both, that he began to experiment, conceived the idea of eating only the pulp of the fruit, rejecting the skin and seeds. From that moment his physical "fall" began, and up to this day, with his refining, his bleaching, his adulteration and his emasculation of nature's good foods he has not ceased to fall, but has further conceived the idea that when an offending (?) organ complains it should be cut out! So much as to the necessity of the human system for the bran, and while not undervaluing the work of the chemist I believe it is wiser, in matters of diet, to turn to nature rather than to the laboratory as the ultimate arbiter. Now as to the material economics of the question.

Mr. Holmes suggests that various substitutes may be used in place of the bran in human diet, but the commonly used materials he mentions are not true substitutes for bran, always including in the term bran all parts of the wheat berry which are excluded from white flour.

Moreover, if such substitutes are used, the fertilizing value of these materials would be lost as would that of the bran, and this loss may be somewhat less than, equal to, or greater than that of the bran, depending on the nature of the substitutes. This point in itself might nearly or quite invalidate Mr. Holmes' whole argument.

It will be objected that graham flour will not keep as well as white flour, but why keep it? Wheat will keep and can be transported to local mills to be ground for immediate use. To supply an equal demand the milling of graham flour would be far less expensive than that of white flour. Of course, the present milling establishments would object to this, but we are considering the interests of the whole people.

Again, suppose the bran be fed to the hog and, to take Mr. Holmes' figure, suppose him to be 15 per cent efficient. It is evident at once that 85 per cent of the potential value as human food has passed beyond man's reach as food, and we have in its place half, or less than half, of the fertilizing value which the material would yield if spread directly on the land. Is it to be supposed that the 15 per cent that the hog's carcass may return, plus one-half the fertilizing value of the remaining 85 per cent, will equal the entire potential food value of the bran if fed to man direct? Since potential human food value is always greatly in excess of fertilizer value this could not be possible.

Nor is this all. Much more land is required to raise the hog to feed the man, also much more labor, all of which might be put to better use.

If fertility of the kind under discussion is to be conserved it would seem that the obvious way to go about it is to remove the sewage from the streams and harbors, thus striking at the root of the evils of waste and pollution. Should this nation survive as long as the Chinese it may reach a position where it will be willing to learn a lesson which the example of that nation might teach us now, had we the wisdom to study it. As population continues to increase it will be found less and less possible to devote land to the growing of livestock. I am not unmindful of the by-products of animal husbandry, such as wool, leather, etc., but that subject is not under discussion now.

To summarize briefly. The human system was designed to handle a considerable amount of coarse and more or less undigestible material, and to deprive it of such substances is to jeopardize health and even life itself. The value of an article suitable for human food is always greater than its fertilizing value. To feed such an article to livestock and subsequently use the animal carcass for human food is both wasteful and expensive.

HORACE A. VAUGHAN.

Assonet, Mass.

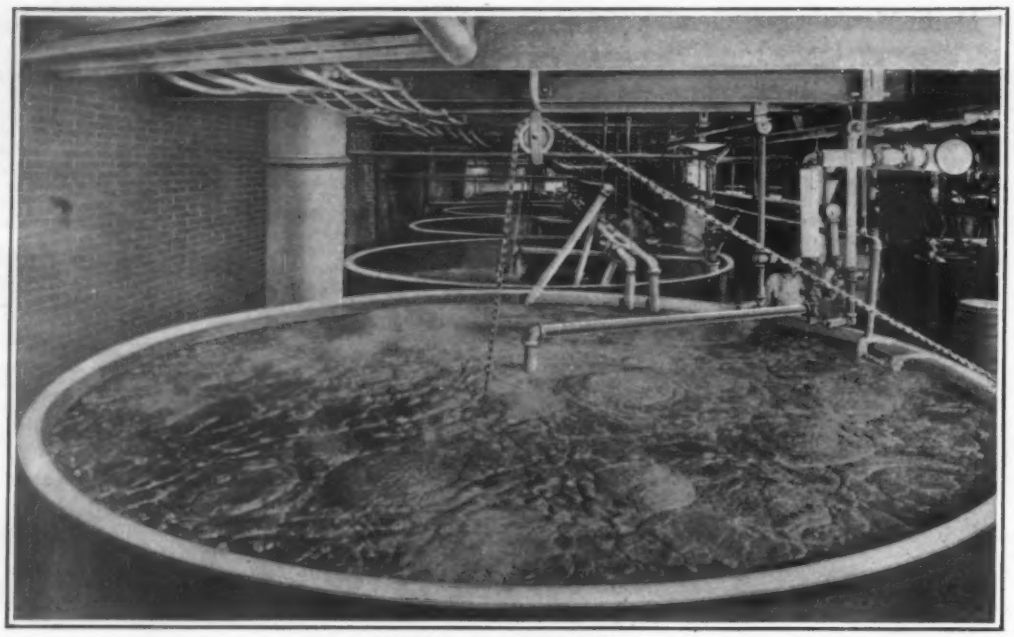
The Art of Soap-Making

An Industry That Has Made Its Greatest Advances in America

THAT soap has been made and used for centuries is evidenced by the finding of a complete soap-making establishment and some well-preserved soap in the ruins of Pompeii. Prior to the invention of this detergent, the ancients used fuller's earth and the juices of certain plants for cleansing purposes.

Old as the art of making soap may be, however, it was not manufactured on a large scale until 1823, and its development into an important scientific industry dates back only fifty years. The greatest advance in soap-making has been made in this country and the American manufacturers have not only been successful in keeping out foreign goods, but have created a number of new soap products that find a ready market abroad.

The whys and wherefores of the making of soap are little understood by the general public. The technical definition of soap as "the alkali metal salt of the higher fatty acids" means little or nothing to the average inquirer, and the current belief seems to be that it is made from the flotsam and jetsam of the animal and vegetable kingdoms by a process of indiscriminate mixture.



A kettle of soap in the making

The most important ingredients in soap are a fat, an alkali and water. The fat may be animal or vegetable. Of the animal fats, those obtained from cattle and sheep take first place, soapmakers nowadays buying the refined product direct from rendering plants. The long list of vegetable fats, obtained from the fruits and seeds of plants, includes the following oils: cocoanut, palm-kernel, olive, cotton-seed, linseed, and, more recently, an oil imported from Manchuria called soya or soy. Soda and potash are the alkalies employed the former for hard soaps, the latter for soft.

The dirt that accumulates on our flesh is greasy, a mixture of dust and the oil from the skin. Before water will remove this greasy dirt, it must be first dissolved, and this is the province of soap. As an excess of fat would only add to the grease already present and an excess of alkali would burn and dry the skin and rot and perforate clothes with minute holes, it will be realized that the proportions of the various ingredients must be balanced to a nicety.

Perhaps the most interesting feature of the largest and most modern soap factories is the kettle room—this by reason of the colossal size of the kettles, the ones illustrated here having an individual capacity of 350,000 pounds, the equivalent of ten to twelve carloads of finished soap. These kettles are constructed of steel plates, riveted together, and have a cone-shaped bottom. They are heated by steam coils located in the base and are provided with inlet pipes for water, lye and raw materials.

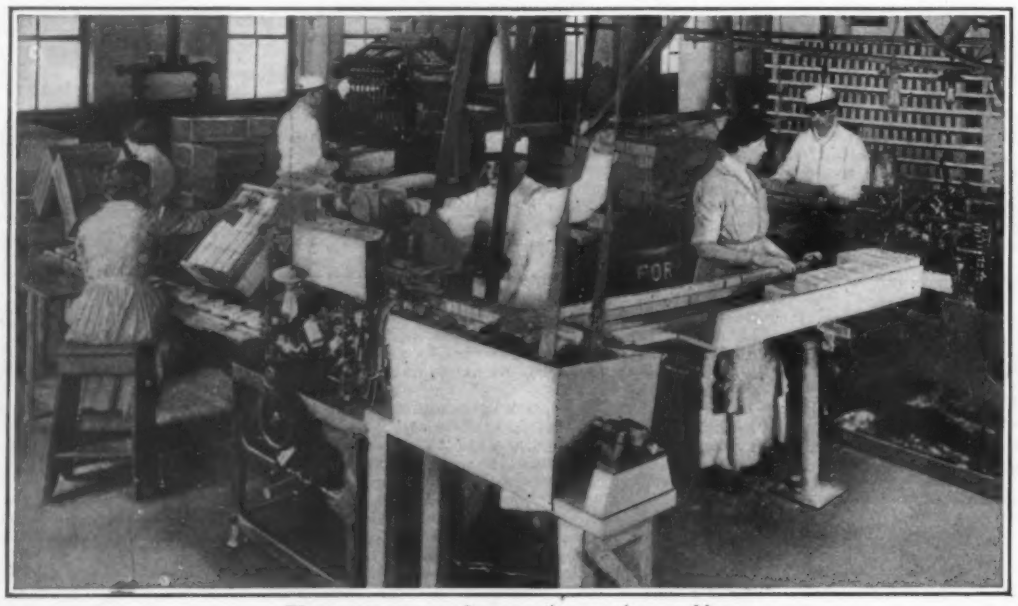
Besides being interesting from the layman's standpoint, the handling of the embryo soap during the boiling process is said to require the highest possible efficiency on the part of the workers. In other words, the output of a soap factory can be intrinsically no better than the degree of merit it attains in the kettle room.

The fats, known as "stock," are run into the kettle and an alkali added. Then a chemical change takes place called saponification, a splitting of the fats into their component parts, fatty acids and glycerine. In this separation, the fatty acids combine with the alkali, rise to the surface and constitute the base of the soap, while the liberated glycerine and any excess alkali settle to the bottom. Now, glycerine is a very valuable commodity and every effort is made to recover as much as possible from the decomposed fats, the liquor being withdrawn from the base of the kettle at frequent intervals. Excess water is removed by the addition of salt.

The kettle is put through a number of boilings, and after the final one the soap is allowed to cool off from the boiling point to approximately 140 deg. Fahr. This takes from seven to twelve days. All told, the soap is in the kettle about two weeks.

As the impurities in the soap settle to the bottom of the kettle, the finished product is drawn off from the top. This is accomplished through a swing-joint pipe projecting midway inside the kettle. After this pipe is lowered to a point near the bottom of the pure stock, the soap is pumped into a crutcher, a mixing apparatus that beats the soap into a smooth, homogeneous mass by the motion of paddle blades revolving on a central shaft; the operation is called crutching. Perfume, coloring matter, etc., if needed are added in the crutcher; resin, however, is incorporated during the boiling process.

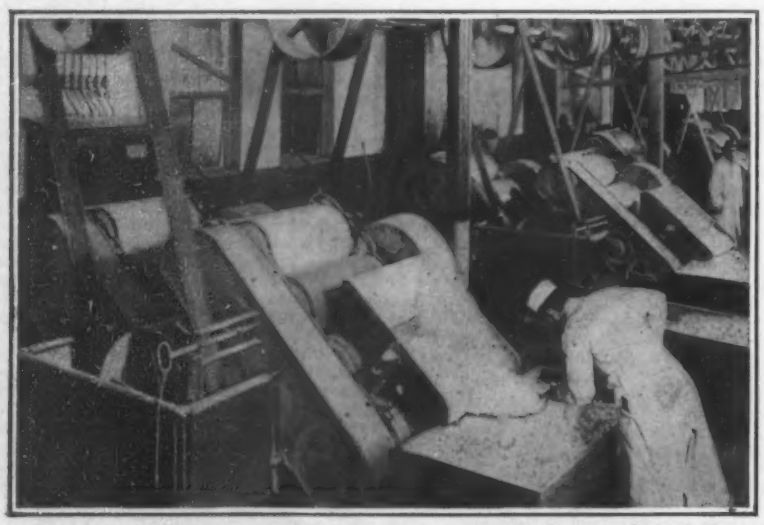
From the crutcher, the soap drops into boxes on wheels, called "frames," which are immediately rolled into a cooling room. These frames are of the same capacity as the crutcher, twelve to fifteen hundred pounds, and are made with detachable sides. When the soap has hardened to such a degree that it can be easily handled, the sides of the frames are "stripped" and the blocks of soap removed. They are then ready to be passed through cutting machines which divide the block first into slabs, then into strips and lastly into unfinished bars. These individual bars are placed in artificial drying rooms, after which they are turned over to power presses and wrappers, speeded up to 60,000 cakes daily per machine.



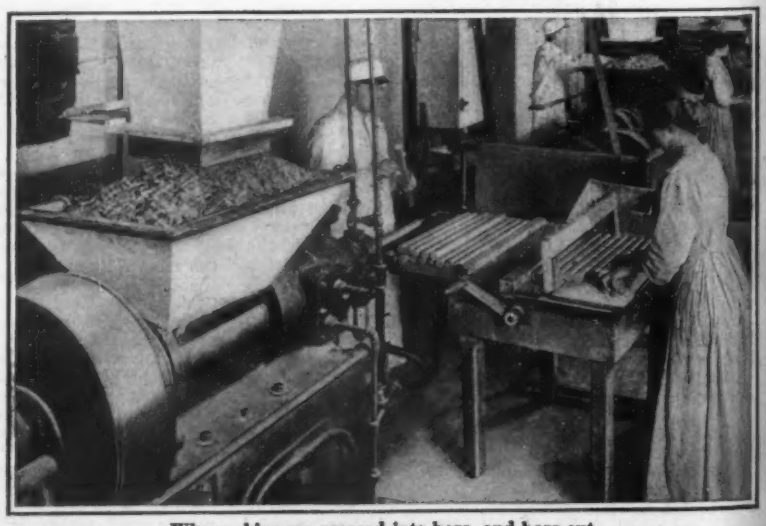
The power press and automatic wrapping machine

The kettle room process is the same for toilet and laundry soaps except for the quality of fats used, but here the similarity ends. Toilet soap does not go to the crutcher and frames, but is passed directly from the kettle through a drying machine on aprons. The required degree of dryness is reached in a few minutes. The soap then passes to a mixer and a mill, where perfumes and coloring matter are added.

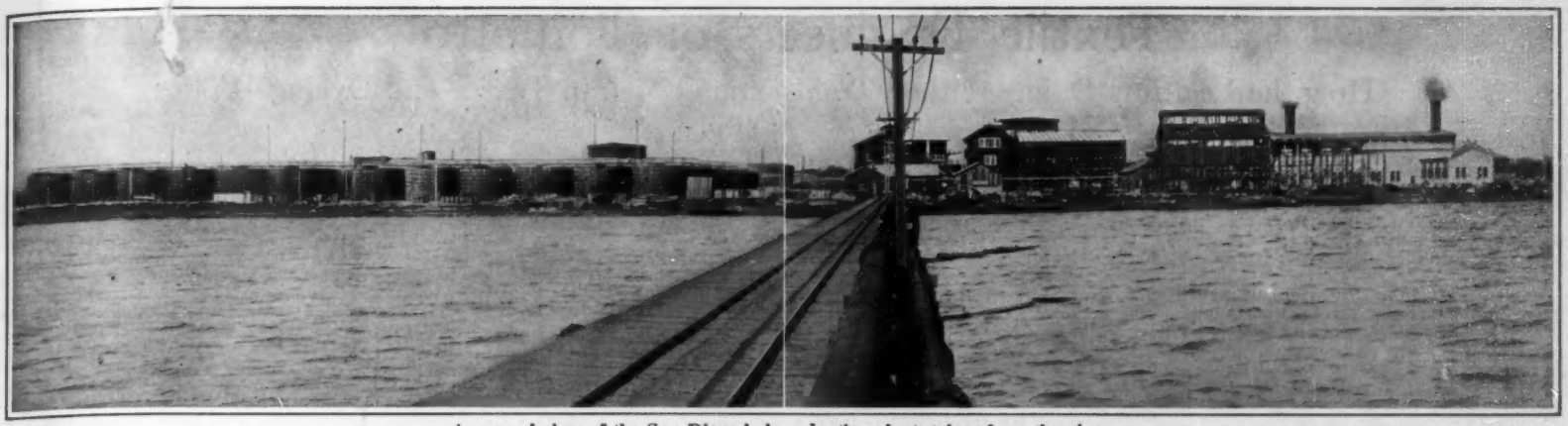
A toilet soap mill consists of a number of revolving stone rolls set closely together in an iron frame. The effect on the soap is to condense it. The soap leaves the mill in the shape of thin ribbons, a form effected by serrated knife edges adjusted against the last roll. A machine, called a plodder, then compresses the soap into solid, compact mass and delivers it in a continuous roll of any desired diameter. Sections of the roll are removed as fast as ejected and cut by wire into individual bars, which are pressed into cakes, wrapped in the many styles of fancy wrappers and placed in cartons.



A battery of toilet-soap mills, which condense the dried soap and give it consistency, color and odor



Where chips are pressed into bars, and bars cut up into cakes



A general view of the San Diego kelp reduction plant, taken from the pier

Sea-Weed for War

By Edward C. Crossman

A FAR cry it is from the quiet fields of brown sea-weed rising and falling lazily on the usually calm waters of the Pacific to the earth-shaking drum-fire of a Flanders offensive. Yet so closely are the two related that there stands at the southernmost tip of California, guarded by a company of United States soldiers, a plant costing one and a half million dollars and devoted to the sole purpose of converting the sea-weed into high explosives.

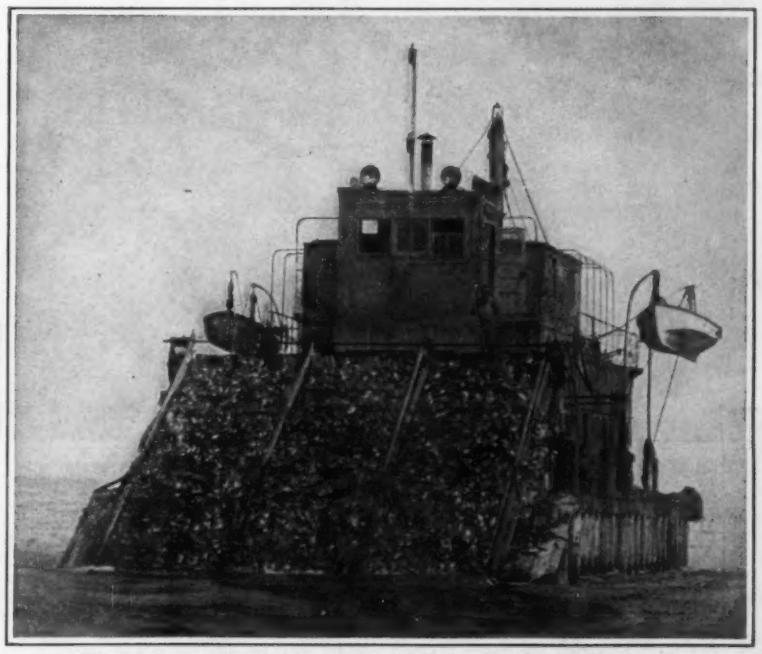
Over nearly every stretch of rocky bottom along the blue Pacific from Alaska to the tip of the Lower California peninsula there grow the fields of giant kelp, cursed by mariners, a stench to high Heaven when it washes ashore during a storm—a California version of the Sargasso Sea. Yet in the salty brown uncultivated no-man's fields, unharvested save in spasmodic fashion, there floats more than two million tons of potassium chloride, not to mention the precious gun-cotton solvent acetone and other by-products of the kelp. And the salts are available not merely once but three or four times a year, as a farmer cuts his alfalfa. It is any man's crop for the harvesting nor does he need to return to the field fertilizer or seed or labor before another crop is his.

On the Southern California and Lower California Coast there grow the fields of Macrocystis; north of Point Sur comes the Nereocystis—the "black kelp" where the Macrocystis is the "brown." Give it a rocky bottom for its anchoring "holdfasts" a constant movement of the water to bring to it the essential carbon dioxide and mineral constituents and a depth of water from 30 to 60 feet and the great "potassium plant" asks no more. From the holdfast attached so firmly that a good sized rock can be lifted by the stem of the plant there shoot upward toward the light the long stems or stipes of the southern coast kelp, the Macrocystis. At intervals along the stem there sprout forth the brown leaves with a little hollow chamber—pneumatocyst—at each leaf group. A stem may be from 75 to 1,000 feet the latter of course the exception. The leaf is about a foot long and a third as wide. The color of the plant is a peculiar tobacco brown almost translucent. It is supposed to be perennial.

This southern kelp occurs in great beds or groves—as it would appear to a diver on the bottom of the sea—miles in length and sometimes a mile or two wide. Like the northern black kelp it furnishes a forest place of refuge for fish. When a stem is cut as in harvesting, that particular stipe dies down but new stipes immediately spring up from the root as wheat stools out. So it can be cut—not below a depth of six feet from the water surface—four to six times a year—opinions varying.

The northern kelp occurs in the same situations—rocky bottom, open water not too deep. The float or pneumatocyst is larger than on the Southern variety, being seven or eight inches long and giving the kelp its popular name of "bladder kelp." When dried, losing six-sevenths of its weight in the process, the southern kelp, used thus far in the big commercial operations, contains about 16 per cent pure potash. Although the Atlantic variety of kelp contains but a fifth of the potash in the Pacific varieties, it has been used for years for a fertilizer in its crude state. Kelp Day is a recognized institution on the New England Coast. The northern Europe countries know and make use of it, while it aids many an Alaska ranch, not too far from the salt water.

It is worked on the Pacific Coast in every stage of a still infant industry, from the crude phase of the beach-combers who rake up the washed-in masses and burn them and sell the ash, through the more systematized one of cutting the kelp and calcining it in furnaces built for the purpose, to the gigantic but still experimental plant of the powder company at Chula Vista, where a fermentation process yields not only potash but the still more desirable acetone.



The harvester, showing how the cut kelp is carried up the conveyor to the macerater

Thus far lack of economical processes of harvesting and handling have made the kelp industry an uncertain one—just as great placer fields in California lay untouched in early days, because in spite of their gold, the early miner could not handle them with profit. But the war made American potash production a vital necessity; so before war had gone very far, there sprang up on the south Pacific Coast various and sundry plants with designs on the peace and quiet of the brown kelp. Some of these plants actually put in harvesters and cut kelp and produced potash and other things, including awful smells; others produced mainly highly decorative stock certificates, some of which proved to be far more ornamental than useful from the financial standpoint of the buyers.

The early seekers of fortune via the kelp route used to harvest with piano wires, snaking the whole plant up by the roots. So the kelp was taken over by the California Fish & Game Commission, because of the feared damage to the fish that use the kelp as shelter and deposit for egg. Now the Commission controls the situation, stops the cutting when it threatens to damage a bed, and limits the depth of the cut to six feet, which leaves plenty of plant for another call and still others through the years. The Federal Government has a very complete experimental and observation station at La Jolla, just north of San Diego, and in the midst of large kelp beds; but as before stated, the knowledge of the plant and the business as a whole is still very much in its infancy.

Strangely enough, while kelp has been sought for its potash, it offers a still more valuable product in these days of war—this being the volatile, pungent liquid known as acetone, one of the few solvents

(*Concluded on page 238*)

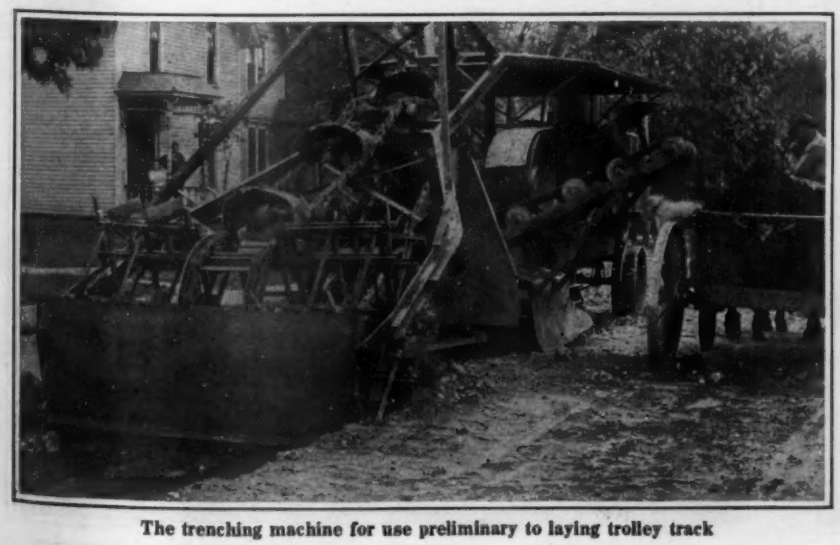
Clearing the Way for the Trolley

THE present day tendency in all lines of effort is toward special machines for special work. Such machinery when correctly designed will do its work more rapidly, more satisfactorily and more economically than it is possible to do it with general machinery and general methods.

A case in point is the equipment recently developed at Rockford, Ill., for doing the work preliminary to the laying of trolley tracks in streets and roadways. It will be realized that such work consists in the excavation of a trench, equal in depth to the combined height of tie and rail, and of width corresponding to the length of the ties. Only by means of such a trench can the surface of the rails as finally laid be made to come flush with the surface of the road, and thus keep out of the way of vehicular traffic.

Now it is obvious enough that this trench could be dug by hand or by any machine that will dig at all. It should be equally obvious that it will be most effectively and economically dug by a machine built especially for that purpose—a machine that will go to exactly the right depth and exactly the right width at a single bite, instead of chipping out the ditch in small pieces. And when we have such a machine, we discover an advantage in its use which we might have failed to anticipate; the track trench of uniform width and depth, with the sides straight and true, will require less ballast than is called for by a roughed-out trench of uneven depth and broken sides.

The machine itself, it would seem, is sufficiently described by our preliminary remarks and our pictures. It is just another of those wholly sensible and eminently good things concerning which, when they are finally realized and brought to our attention, we can only ask: "Why did nobody ever think of that before?"



The trenching machine for use preliminary to laying trolley track

Completed trench ready for ties and rails

Textile Engineers of Tomorrow

How the Learn-by-Doing Method Trains Young Men in Textile and Dyeing Work

By Our Field Editor

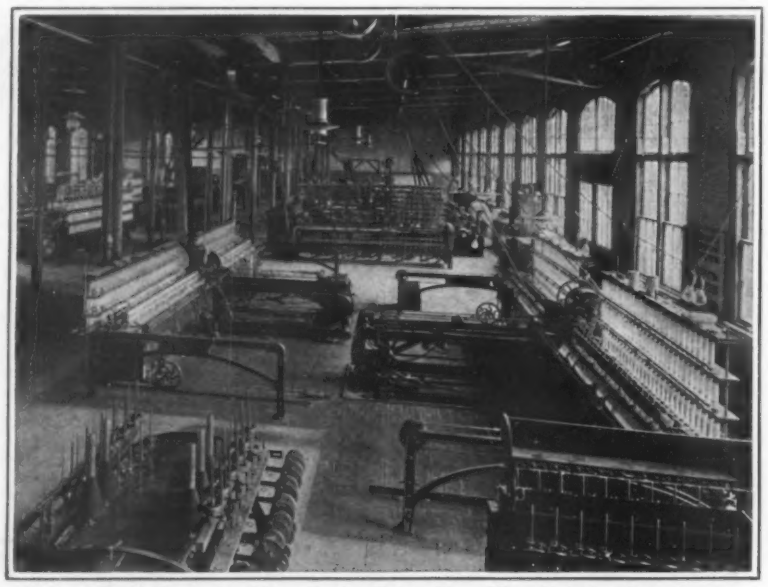
THE first day out from Boston on a tour of the leading New England cities, the writer ran into Lowell, Mass., well known as a textile center. In order quickly to get in touch with the latest activities of the city—technical activities—the writer dropped in on the city editor of the leading newspaper.

"What is there in this town that would be of interest to our readers?" was the question put after the proper introduction. "The Lowell Textile School; don't miss it!" was the prompt answer. And that is how this story came to be written.

Modeled on the lines of the departments of the higher polytechnic institutes, the Lowell Textile School offers thorough instruction in the elements and principles of the sciences and arts applicable to textile and kindred branches of the industry. Its courses of instruction treat of the application of these principles in the processes and machinery required in the manufacturing of all kinds of textile fabrics.

In industrial education the distinction between trade and technical industrial schools is coming to be understood. The Lowell Textile School belongs to the latter class. Beginning with limited equipment, instructing staff, and means, instruction at first was by mill or trade school methods—the pupil was brought directly to the machine, and its parts and operation in manufacturing explained to him. The curriculum was, however, rapidly extended, as contemplated in the original plan of the founders, and department after department opened and equipped, and commodious and well adapted buildings provided for a permanent home. So the school at present, housed in a group of handsome buildings overlooking the Merrimac River on the outskirts of Lowell, serves at once to give its students a thorough technical education and a practical experience with machinery and processes. In short, its students are as much at home with the slide-rule and the text book as they are with overalls and oil can and weaving machinery; which means, in translated form, that they are practical men.

The main impression one receives from a journey through the Lowell Textile School is a mass of complicated and almost human machinery. For room after room in the group of school buildings is crowded with equipment; occasionally, a class is found at work, with the instructor, sleeves rolled up, showing a small group of overall-clad students how to go about a certain process. Team work is strikingly evident in such a class. One student stands at the control of the machine, two others treat the fabric in a certain bath, two others take the fabric and carry it to the machine where other students help thread it in and out of the rolls. Indeed, the whole process is strongly suggestive of shop conditions, and the students appear to take it quite as seriously.



Part of the elaborate machinery in the Cotton Yarn Manufacturing Department

The school offers three courses which are designated as follows: Cotton manufacturing; wool manufacturing; and textile design, or general textile course.

The first of these, or cotton manufacturing course, is designed for students contemplating a career in the manufacturing of cotton yarns and cloth or allied industries and who wish to devote but three years to the school work. During the first term the studies are common to all courses and include instruction in mechanism, mathematics, mechanical drawing, textile design and elementary chemistry. Laboratory work supplements the lectures on chemistry and hand loom weaving assists in illustrating the principles of textile design. At the commencement of the second term, instruction in the preliminary processes of yarn manufacturing is given.

The work in the cotton yarn department comprises instruction in all the manufacturing processes from the bale to the finished yarn. The instruction is given by means of lectures upon the machines and processes, and by laboratory work upon the machines themselves. In the laboratory each student is required to make exhaustive tests upon each machine and to make as many settings and adjustments as possible. The third year's work in this department is largely devoted to lectures upon the manufacture of specialties, waste products and so on, and special laboratory work, special tests upon yarns and fabrics, mill planning with regard to the arrangement of machinery, and other work of an advanced nature. So, to be sure, there is little that a graduate does not know concerning cotton goods.

The course in wool manufacturing, on the other hand, is arranged for those who contemplate a career in the manufacture of woolen or worsted fabrics and can devote but three years to the school work. It includes instruction on all of the varied processes employed in adapting the wool fiber to cloth, namely, sorting, scouring, carding, combing, spinning, designing, weaving, dyeing and finishing. The work is carried on by lectures, recitations, and practical work in the laboratories.

Following the first term of the first year, which is common to all courses, the student commences work in the woolen and worsted laboratory, and through systematic steps becomes acquainted with the machines employed in the first steps of yarn manufacturing. At the same time lectures are given upon the many kinds of wool, variation in quantity, grades, uses, and so on, as influenced by the locality where grown. This is followed by practical work on the sorting table.

The second and third years cover spinning of woolen yarn and worsted yarn by the Bradford and French systems, also the manufacturing of tops, including combing, gilling and back washing. Scouring and carbonizing are taken up in detail by lectures and practical work. The general chemistry of the first year is followed by textile chemistry and dyeing in the second year. Textile design, cloth analysis and construction are continued from the first year throughout the course, the work being applied especially to woolen and worsted goods. Weaving on power looms commences in the second year and continues through the third. Lectures on finishing commence with the third year and are augmented by extensive practice with the machines in the finishing department.

Work in the engineering department extends throughout all three years and includes mechanical drawing, properties of saturated steam and electricity. The practical application of the principles studied in these subjects is brought out forcibly in the work on mill engineering, where mill design and construction are considered. A short course covering methods employed in the testing of fibers, yarns and cloths, together with laboratory work in the manipulation of certain physical apparatus, is given in the third year.

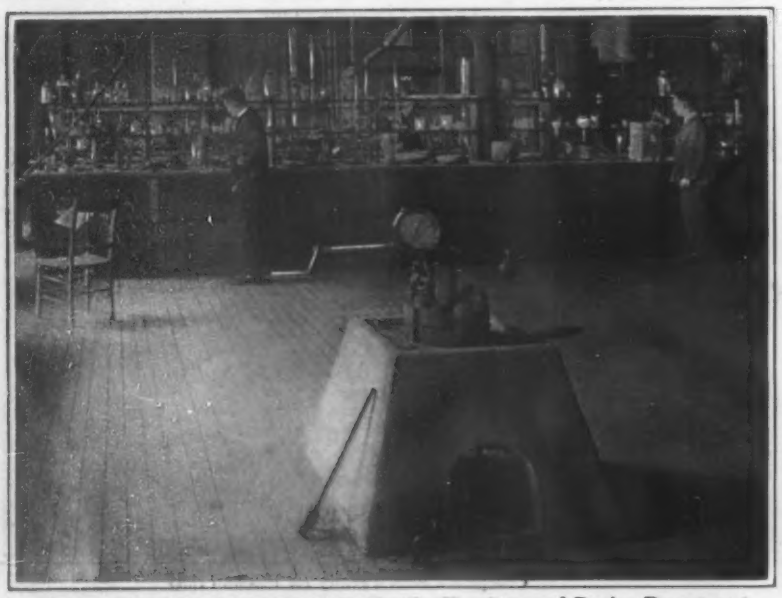
The general course in textile design is planned to meet the demand of young men for technical training in the general processes of textile manufacturing, but with particular reference to the design and construction of fabrics. To this end a foundation is laid in the first year by instruction in the elementary principles of designing, decorative art and weaving. That he may later in the course pursue to advantage instruction in yarn manufacturing, weaving, dyeing, finishing and some engineering problems, a foundation course in mechanics, mathematics and chemistry is laid. As a student is required to pursue courses in the yarn departments, both cotton and wool, he acquires a knowledge of the manufacture of cotton yarns from the bale to the yarn, and of wool and worsted yarns from the fleece through the varied processes of manufacturing woolen yarn or worsted yarn by both the French and Bradford systems.

Throughout his entire course he receives instruction in design, cloth analysis and construction of all the standard cloths, viz., trouserings, coatings, suitings, blankets, velvets, corduroys, plushes, and so on. This is followed by advanced work in Jacquard designing and weaving which serves not only to acquaint the students with the many kinds of cotton, woolen, worsted and silk fabrics of figured design, but stimulates and develops any artistic talent he may possess. Decorative art becomes an important part of the work in the second and third years. The engineering subjects given in the second and third years are intended to acquaint the student with such general knowledge as will be of assistance should he be called upon in later life to be a mill manager or should his subsequent progress lead him to some executive position in the operation of a textile plant.

A touch of particular interest is presented in the graduation suits made from the cloth turned out by the men who have pursued the wool manufacturing or design courses. This has been carried on this year and the cloth satisfactorily completed. The manufacture of this cloth is really a commercial problem from the fact that a student must first decide the type of material he is to manufacture, and must then make proper design and all calculations necessary to determine the amount of grease wool to be purchased. He then arranges through the school for the purchase of this and carries the wool through the various processes of manufacture until it reaches completion in the finishing room. He is obliged to keep a record of his procedure at every stage of the manufacture of this cloth, so that at the end he has a knowledge of the magnitude of the various losses which must invariably take place. Students in the engineering and chemistry classes before graduating are obliged to carry on some investigating work and to prepare theses of their results. All of which, of course, fits in with the idea of learning by doing.

This year, the writer was informed by Mr. Charles H. Eames, principal of the school, the demand for the graduates has been greater than ever before. Of course this is quite natural because of the fact that various departments of the Government are not only seeking technically trained men who are graduating from higher institutions of learning, but are also taking such men from the industry. This naturally handicaps the industry, and they endeavor to replace the men whom they have lost by technically trained men who are coming from the schools. It has been impossible to fill the demands that have come to the school from both the Government and the manufacturers.

While dwelling on the question of technical training, one cannot help but realize how seriously we were handi-



Organic chemistry laboratory of the Textile Chemistry and Dyeing Department

Experimental dyeing laboratory of the Textile Chemistry and Dyeing Department

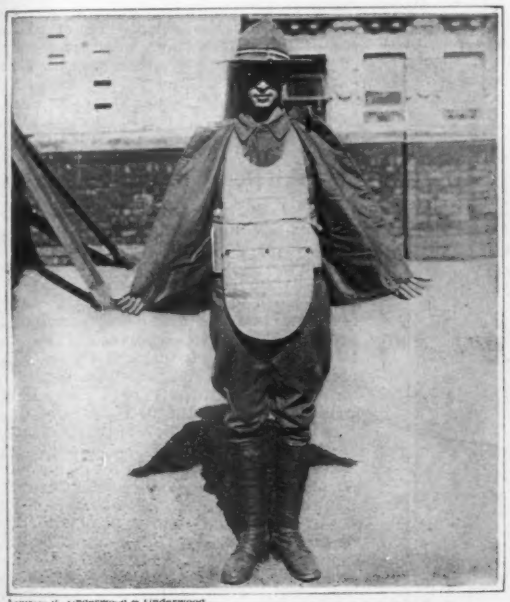
capped for technical men at the outbreak of war. With the restoration of peace conditions and the great competition that must no doubt follow between the industries of all countries, it seems that now is the time for us to prepare our young men for the coming peaceful, but nevertheless vitally important, struggle for trade. This is a proper time for young men to consider the value of technical training and to enter the higher institutions of learning, so as to be ready to enter the ranks of industry with the advent of peace. The call is bound to be for many men, particularly in such specialized branches as the textile industry.

To this end the action of the Government in encouraging young men to continue in higher institutions of learning in order that they may be of greater service when they graduate, is highly commendable. It is a wise precaution for war as well as for peace. And no better proof of the value of these men to the Government at present can be found than the service flag which waves before the Lowell Textile School, on which many a star stands for a technically trained man who is now an officer in the Army or Navy.

It is quite likely that before this article gets into print the Lowell Textile School will be taken over as a State institution by the State of Massachusetts. At the time of writing the bill is in the Legislature, permitting the state to take over all the textile schools. This is in accordance with the Anti-Aid Amendment to the Constitution which was ratified last year.

Armor For the Protection of Soldiers

THE Germans are fighting their rear-guard actions mainly with the machine gun, and it is probable that by far the larger part of the casualties are due to machine gun bullets. The suggestion has frequently been made that losses of this kind could be largely reduced by providing the attacking troops with some form of body armor. The Germans indeed, have already made use of it; complete sets of steel-plate armor having been found which are stated to weigh about forty pounds each. The accompanying illustration shows a bulletproof vest, which is very much lighter than the German armor and yet is stated to offer sufficient resistence to stop the bullets from revolvers or shrapnel. It is said to be proof, also, against the bayonet and the fragments of the hand grenade. Its weight is only 4½ pounds and official tests have shown that it will completely resist shrapnel at 1,200 feet per second velocity, and that it is proof at any range against revolver or pistol bullets, including the German .30-bore, Mauser automatic pistol, using German bullets with solid conical heads. The composition of the shield is not stated.



Copyright, Underwood & Underwood

Body armor for the protection of soldiers

Ammonia as Fertilizer

AT a recent meeting of the Académie des Sciences, M. Schloesing showed that nitrate of ammonia forms an excellent fertilizer. He finds that in a given soil, counting the yield without the use of any ammonia fertilizer as 100, it rises to 122 with the use of sulfate of ammonia—the product commonly employed—and to 123 for nitrate of ammonia. This latter had not as yet been used for fertilizing purposes. These researches show that there is a large outlet in the future for plants which are now engaged in the manufacture of the nitrate for loading of shells.

Copyright, Underwood & Underwood

French light shoulder machine gun, with bipod

The Light French Machine Gun

IN the open fighting which has characterized the operations of this year on the western front, the automatic rifle and the machine gun have formed most efficient weapons both of attack and defense. In fact the retreat of the Germans has been covered mainly by concealed machine guns. The accompanying illustration shows the French form of the light machine gun, which like our own Browning gun is provided with a shoulder stock, and a light forward rest, attached below the barrel. The cartridges are fed to the gun from a semi-circular magazine, containing 20 cartridges, which can be quickly clamped in place. The man in the foreground has in his hands one of these magazines and the removal of the empty case and substitution of the new one can be done in a few seconds. The gun is known as the Chauchat. It is air-cooled, and the energy of the recoil serves to discharge the empty cartridge case and load and fire the next cartridge, the operation being continuous, and it is so light that it can be fired from the shoulder, without the rest, or from the hip. In the latter case, the gun is slung from the shoulder by a strap.

German Anti-Tank Shoulder Rifle

DURING one of the recent successful attacks of the Canadians against the German lines one of the tanks picked up an abandoned rifle designed to penetrate tank armor. The object of the Germans in producing this gun was to provide a weapon that would be midway between the light rapid-fire one and three-pounders, and the ordinary shoulder rifle, whose bullet is unable to penetrate the tanks. It was necessary to provide a heavier bullet and if possible secure a higher velocity. According to the description which has been sent across from France, the cartridge for this rifle is about five inches long and the bore is one-half inch. Judging from the great length of the gun which, over all from the butt to the muzzle, must be about five feet six inches, the muzzle velocity should be as high, if not higher, than that of the standard rifle used by the German infantry. We must confess that we fail to see how this rifle could do very serious damage to a tank. Even if its bullet got through, its destructive work in the interior would be very limited. The most effective weapon against the tank is the 1½-inch gun which is used by our own and the French army.

Straightening Hardened Tools

THE substitution of machinery for the human hand and eye has solved many industrial difficulties, but there are outstanding instances in which such substitution has not yet been effected, notably in the straightening of twist drills, and sewing-machine needles. In straightening twist drills the workman is provided with light hammers and surface plates, the latter being mounted on a level with the workman's eyes so that he can see daylight between the defective drill and the plate. He strikes the drill with the hammer at the point that experience determines to be the place where a blow is required and rolls the drill on the plate to test it.

Automatic machines for doing this work have been developed, but they were commercial failures. The same conditions exist in the sewng-machine needle industry, where also it is necessary to straighten defective needles by hand. For straightening twist drills a hard steel plate is provided about eight inches square and 1¾ inches wide with a V in the center about $\frac{1}{4}$ inch wide. This plate is set in front of a window at an angle of 15 degrees, inclined towards the workman. The needles are rolled with the fingers on this plate, and the operator is governed by the shadow that the needle throws upon the plate. If the needle is crooked it will show by this shadow the amount of its eccentricity, magnified as the error is multiplied by the shadow, owing to the angle of the plate. The operator uses a small copper hammer to straighten the needle, placing the needle over the V and striking a blow in the right place as experience and judgment may dictate.

Abandoned German Big-Gun Emplacement

THAT Germany, when she made her last big drive in the Marne salient, was fully confident of its success is proved by much tangible evidence, such as the vast stores of munitions and supplies that filled the salient, much of which had to be abandoned and fell into the hands of the Allies. The accompanying view of a big-gun emplacement which was discovered when the Germans retreated, proves that they fully intended to carry their attack right through to Paris itself, and a dispatch from the *Petit Parisien* states that they had prepared special siege artillery with which to render the city untenable. The largest of these pieces were 16-inch guns of 45 caliber, which weighed 110 tons and had an estimated range of over thirty miles. The shells, according to this authority, weighed 1,600 pounds each and were charged with 75 pounds of high explosive. The guns were already mounted on trucks, ready to be taken to prepared positions. If the *Petit Parisien* is correct, these guns would not have been of sufficient range to reach Paris from the point where the foundations and turntable herewith illustrated were found, since the distance is about fifty miles; but it is possible that they had prepared some long-range rifles of the same general type as the 75-mile guns which have been firing on Paris from the Forest of St. Gobain. The photograph shows that the turntable was mounted on ball bearings, which are clearly discernible. Apparently the traversing of the gun was done by means of two electric motors, bolted to the turntable, which operated a common shaft, at the center of which was a worm. This meshed with a worm-wheel at the top of a vertical shaft, at the bottom of which was a gear wheel that was to have engaged a rack bolted to the permanent platform below. This gear will be noticed in the forefront of the picture. To the left of it there is an enclosed winch, the hand-operated crank of which is clearly visible. This was probably intended for lifting the shells and powder to the breech of the gun.

Copyright Underwood & Underwood

Anti-tank rifle captured from the Germans

Copyright, Underwood & Underwood

Foundation and turntable for long-range German gun, abandoned during the Marne retreat

The Motor-Driven Commercial Vehicle

Conducted by VICTOR W. PAGÉ, M.S.A.E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

Using the Motor Truck to Fight Mosquitoes

THE picturesque "skeeter man," with his knapsack on his back, and his hand sprayer may soon become a rare sight, and to see him we will have to go back into the swamps, far off the road; for a western man has hit on a scheme which makes it possible to use a motor truck in fighting mosquitoes along the roads and in the fields wherever a machine can go.

The power sprayer consists of an air compressor mounted upon a motor truck, and operated by the same engine. The oil is sprayed by means of the compressed air. A long hose permits a wide radius of operation.

The apparatus, which promises to revolutionize the present method of oiling mosquito breeding pools, was devised by T. L. Murray, superintendent of the Pulgas Mosquito Abatement District, in San Mateo County, California.

Where the Trailer Made Good

IF the average business man were told that the most profitable way to use a motor truck is to run it empty, he would probably consign his informer to the gentle care of a commission in lunacy. But the owner of a certain slate mine in the up-state part of New York would merely nod wisely and remark that he had noticed the same thing.

The quarry in question is a mile and a half from the railroad station. The running time for a round trip is accordingly small, in comparison with the combined loading and unloading time. This brings it about that when the truck is used in the ordinary way, as a truck for carrying the slate, it spends most of its time standing dead at the shaft-house or the station, being loaded and unloaded. This, of course, is plainly bad; but the remedy requires a good deal of vision in the seeing, and even more nerve in the believing.

In the present case, after a good deal of persuasion, the quarry man was brought around to give the trailer a trial. He brought three of these and issued orders that henceforth the motor truck was not a truck at all, but simply a locomotive. It runs continuously, never carrying a load on its own bottom, but always hauling one trailer. It leaves the mine in the morning with a loaded trailer, hauls this to the railroad, picks up the empty trailer left at the last trip, drags this back to the mine, and when it gets there the third car is loaded and waiting. In this way there is always one trailer loading, one unloading, and one en route in one direction or the other. Twenty round trips are made in a ten-hour day, and six tons of slate delivered each trip. Operating on this schedule, the cost of hauling the slate to the trains has been cut in half, and the owner, who was frankly sceptical over the idea of running his truck with all that space on its floor yawning to the skies for a load, is enthusiastic over the trailer.

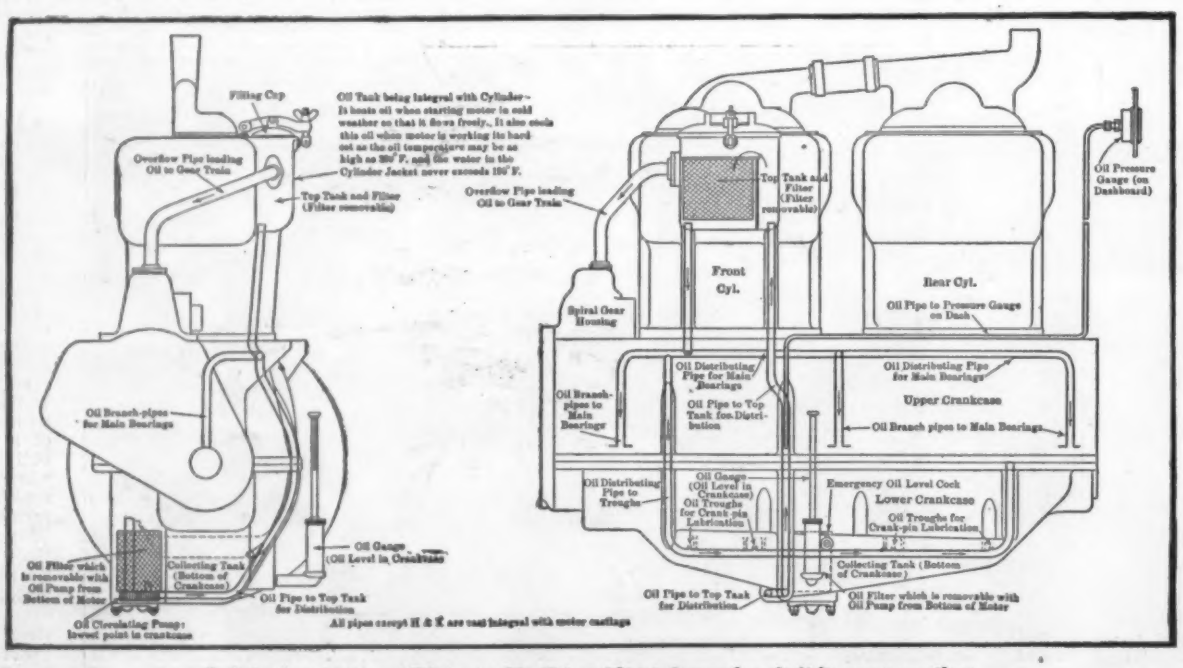
Simple and Effective Oiling System for Truck Motor

THE necessity of securing positive lubrication of motor truck engines is now so well recognized that truck designers give this matter considerable attention. A very effective oiling system that is distinctive in several features is shown as an example of the care taken in designing and is found in a leading American motor truck line. The oiling is practically a dual form. All interior parts are oiled by splash, except main bearings which are oiled by gravity feed. The lower crankcase acts as a large oil reservoir, carries the oil pump, has oil troughs cast integral with it and also has fins cast along the bottom to aid in cooling the lubricating oil. The front cylinder has an oil reservoir cast integral with it and this is partly water-jacketed. The oil piping is cast into and is integral with the upper and lower crankcase and the front cylinder. There are but two external oil pipes; one leads from the cylinder oil reservoir to the magneto timing-gear housing, and one from the crankcase to the oil pressure gage on the dash. The oil pump is of the spur-gear type, a complete unit, and can be removed from the engine without disturbing any other part. There are two oil strainers, one surrounding the pump and one in the cylinder reservoir. The oil in making its circuit passes through both strainers.

The system operates as follows: Oil flows from the crankcase reservoir through a strainer into a pump, is pumped to the cylinder reservoir, passes through another strainer, and flows by gravity through pipes to the oil troughs in the lower crankcase. There is an oil splasher on each connecting road cap which is forged integral with the cap, machined hollow and bent. This splasher dips into the oil in the trough, forces it into the connecting rod bearings and originates the oil splash. The whole interior of the engine is thus kept flooded with lubricant which flows over all the wearing surfaces and into wrist-pin and camshaft bearings. The surplus oil settles into the crankcase reservoir, enters the pump and again makes its circuit. Oil is led directly into the three crankshaft main bearings, flowing by gravity through the pipes from the cylinder oil reservoir. The pump is designed to supply an excess of oil to the cylinder reservoir, this excess flows by gravity through a large external pipe to the magneto timing gear housing, keeping all timing gears lubricated by the constant overflow of oil. This system provides against the most adverse conditions. In cold weather when the oil is thick and heavy and does not flow readily into the small interstices of the bearings, it is heated in the cylinder reservoir by the jacketed water. In warm weather, or when the engine is working under heavy loads, the oil is prevented from being overheated by the jacket water, which cannot become hotter than the boiling temperature (212° F.). The fins cast on the bottom of the lower crankcase also assist in cooling the oil by radiating excess heat. In cold weather, bearings are not destroyed before the oil comes to the proper viscosity to flow into them, and in warm weather, or when the engine is heavily loaded, they are not destroyed by being overheated. Provision has been made for the two extremes. The breathers for the release of crankcase compression have their passages through the valve spring chambers, which are enclosed, allowing the valve springs and lifters to operate in a haze of oil, thus keeping them properly lubricated at all times.

A sprayer for oiling mosquito breeding pools

The motor truck that is never loaded



Lubrication system which heats the oil in cold weather and cools it in warm weather

The Rocky Road to Bolivia

"TOO much care cannot be taken in packing merchandise consigned to interior points in South America," urged the representative of a Bolivian firm. "Let us follow a shipment from New York to La Paz, for instance, and see how many times it is handled in transit. From the exporter's warehouse it is loaded on a truck and taken to the steamship pier, then placed on board the vessel, which takes it to Colon, Panama, where it is dumped on the dock pending the arrival of another steamer that conveys it to Mollendo, Peru. There are no piers at the latter port, so the shipment must be transferred to a launch and landed on shore to be taken by means of hand-carts to the railroad station. After traveling in a freight car to Guaci, it is moved to a steamer that carries it over Lake Titicaca to Puno, where its railroad journey is resumed until it finally reaches La Paz, to be taken by Indians to the customer's warehouse. So you see the necessity of adequate protection from the 16 separate handlings to which the consignment is subjected.

"Pilferage is another thing to be guarded against. The best preventive is a stout shipping case around the ends of which metal edging has been nailed and painted so that it will show marks if tampered with."

Largest French Cargo Boat

ON April 24th last, the largest steamer ever built for the French merchant marine was launched from the Chantiers de France at Dunkirk, France. The vessel measures 444 feet in length, displaces 19,000 tons, and has a total carrying capacity of 12,000 tons.

The Germans tried to destroy the ship by aerial bombs, with long-range guns and by destroyers. The successful completion of the work is a wonderful tribute to French determination in the face of almost insuperable obstacles.

The Current Supplement

RUBBER has always been a most important product that is indispensable for very many purposes, and although innumerable chemists have spent many years in the endeavor either to produce rubber synthetically, or to find some substitute, nothing has as yet been discovered that will take its place. So important is this material that for many years the rubber tree has been propagated on a large scale, and now a large percentage of the world's supply comes from the plantations. Considerable information on the subject will be found in a paper on *The Rubber Industry* in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2229, for September 21st. There is an interesting illustrated article on the *Common Snail*. *The Manufacture of Oleomargarine* reviews the history of the manufacture of this well known substitute for butter, and describes modern methods and processes. *Shoes for the French Soldier* gives a sketch of how the wooden-soled shoes extensively used in the armies of our Allies are made, and a number of the processes are shown by excellent photographs. *The International Bureau of Weights and Measures* tells something of the results of the Convention of the Meter, in 1875, and of the problems with which it is engaged. There is an article on *An Optical Method for Accurately Dividing a Circle into Degrees*, which is accompanied by explanatory diagrams. Other articles of moment are *The Waste Sulphite Liquor Problem*, important in the manufacture of paper; *Low Grade Fuels; Prevention of Coal-Dust Explosions in Mines; Refractoriness Under Load; Large Power Stations* and *On the Correction of Optical Surfaces*.

Oddities in Recent Aircraft Design

(*Concluded from page 223*)

It is only when the linen covering is removed from the airplane fuselage that one realizes how much equipment is carried by present-day fighting machines. In the third photograph, for instance, is one of the Salmson two-seater reconnaissance and artillery-spotting machines of the French which are now beginning to appear at the front in large numbers with the French and the American forces. This view shows the fuselage with its full equipment, prior to being covered. The radial 250-horse-power Salmson engine, control stick, belt tube for the forward machine gun, screen-protected fuel tanks, extensive wiring, wireless generator, and so on appear in this view. Attention is also directed to the delicate framing of the fuselage, each member of which is in itself far from strong, yet when combined with the others it goes to make a rigid and remarkably strong structure.

The fourth photograph is of the present Fokker scout, the latest creation of Herr Fokker, the Dutch aircraft engineer residing in Germany. This single-seater biplane is the successor to the treacherous but speedy Fokker triplane which was being employed in fair numbers but a few months ago, and which was the mount of Baron Von Richthoffen on his last and fatal flight. The bracing of this latest Fokker is odd and interesting, since it eliminates practically all guy wires. Another feature is the small plane just below the forward body and between the wheels, which must furnish some lifting effort and thus brings this machine almost, if not quite, in the class of triplanes. In this machine Fokker has abandoned rotary engines in favor of the stationary, six-cylinder Mercedes, with the V-shaped radiator.

The fifth photograph depicts a Caudron twin-engined bomber or reconnaissance plane, which, although modified considerably, can still be traced back to the Caudrons of the early days of aerial fighting. It appears that the engines in this instance are the eight-cylinder, 300 horse-power Hispano-Suiza, a large number of which are being turned out in France both for speedy work and for the larger, multiple-engined machines. The V-shape of the engine is taken advantage of as far as possible; the engine cover in each case is of triangular section, and the struts are arranged in V-form to offer support to the engine. Some of the more important guy wires are enclosed in streamlined covers to reduce wind resistance.

New Cycle in Industrial Organization

(*Continued from page 229*)

Disregard for the health and safety of workers could not but occur under a regime that was typical of the times. It usually was not intentional, although in many cases it was clearly the result of extraordinary conditions. Due to lack of the proper administrative machinery, individuals of certain types who were not physically fitted for heavy work were nevertheless placed upon the wrong positions, with a consequent rapid decline and in many cases untimely death. Safety of workers was disregarded in the same manner and often men whose qualifications did not warrant their consideration for a position of hazardous nature were nevertheless, through the lack of application of intelligence, placed upon such work. Both the worker and the enterprise soon paid the penalty, whether the management knew it or not. While these were matters of serious nature they were usually not intentional, but rather acts of omission than of commission.

The adequacy of compensation has at once become a live question when the administrative machinery for the application of a modern labor policy has been set up. It has such an important bearing on the stabilizing of labor that in enterprises where rates of pay have been given little attention, the establishment of an Employment Department has immediately brought about helpful adjustments that have been an important step in the promotion of a better feeling between management and men. The establishment of an Employment Department has created a specialist who has had to go into the labor market in an intelligent manner, and having the subject of labor as his specialty, he naturally applies his analytical powers and more quickly discovers the inequalities or lack of balance. He soon finds, if his rates of pay are inadequate, that his position in the labor market is weakened. Thus through the proper organization of information he is frequently successful in securing wages for the workers that otherwise would receive no attention at the time and probably not until an acute situation developed.

What the Employment Chief Can Do

Personnel Departments should change a labor policy so that less energy is required for cures through the application of more energy toward prevention. The absolute elimination of unfortunate conditions in many cases, and great improvements in others, have resulted when measures were taken to organize a Personnel, Employment or Labor Department, and thereby apply analysis and special intelligence to questions surrounding the men. The first step usually taken in setting up an organization of this kind has been the opening of a centralized Employment Office. If the enterprise had 400 departments, they all then secured their help through one central office, which made a business of employment and concentrated on that one thing alone. The Employment Office thus became a central clearing house, which might be likened to a valve regulating the flow of help into and out from the enterprise. Organizing an Employment Office meant not only the employing of all persons for the enterprise through that one point, but the dismissal or release of those leaving the business as well. The wrong conditions affecting workers have then become apparent and the necessary steps immediately taken to make the needed change for the reduction of labor turnover. In some instances the establishment of the Employment Office has alone resulted in reductions of labor turnover from forty to sixty per cent within a few months. Occasionally still greater reductions have taken place.

With a centralized Employment Office men do not apply at various buildings or gates in the large plants; they all approach a well-ordered office where they are received as men and not herded around like cattle. They are given individual attention and an endeavor is made to weigh each individual and appraise him at his true worth. Friendship or pull is of no avail. He is weighed on impartial scales and his assets are appraised at their proper values. No graft is levied. He has an opportunity to establish himself purely on the basis of merit.

In case of difficulty leading to his being fired, he has a friendly and impartial agency to which he can go and tell his side of the story. If he has been dismissed unjustly, the Employment Office is in the position of the peoples' lawyer and can act for him in presenting the case before the proper executive. If his dismissal is just, the impartial Employment Office can go farther in pointing that fact out to him and thus lessen the community ill will that is so quickly engendered when a few questionable dismissals take place.

Safety and Training for the Work

On account of the existence of this agency the enterprise is more clearly informed of market conditions and the worker is enabled to maintain himself in a better way because the compensation paid him is more nearly in line with the needs of the times. Physical examination before a physician safeguards him and prevents his taking up work that might result in the impairment of health. The existence of a well organized health department is a further safeguard in the case of accident as it is usually in close proximity to his work and can give him at once the necessary special attention. It is definitely linked up with his working hours. It endeavors to maintain him as an efficient producing unit and sincerely tries to reduce the loss of time and wages in case of accident. It enables him, if injured, to resume earning on a normal basis at a much earlier date than would otherwise be the case.

Further specialized organization in the

(*Concluded on page 238*)

New Cycle in Industrial Organization

(Concluded from page 236)

enterprise provides a Safety Department through which committees are organized for educational and inspection purposes and the opportunities for the worker to do unsafe things are thus reduced. Carelessness is the cause of 80 per cent of the accidents occurring in industry and some astonishing improvements have been made by large corporations in this connection. The Steel Corporation was the leader in this movement and many other industries have since been enabled to produce important results for the workers through influencing them to be more careful. The aim of a Safety Department is first to educate individuals to do their work in the safe way and next to inspect activities so that cases of failure to act in the safe way are discovered before it is too late. The safety movement has such a direct connection with the health and happiness of workers that it has become a distinct and important phase of personnel administrative work.

Training has now become another important phase of personnel work. The modern training department is confronted by the task of changing the situation from one in which individuals are left on their own resources and to a certain degree must instruct themselves, to one in which they receive intensive training and in a very short time reach normal production in their work. In some cases the worker may be on the position three months before he reaches normal production. It is not the special duty of any one person to train him and he has to pick up his own education. In other cases he concentrates under strict supervision, and often reaches normal production in three days. On piece work the effect on his pocketbook is very much in favor of specialized training.

Betterment departments have provided numerous other activities for which needs have been apparent, all looking to increasing the interest of the worker in his job and extending the spirit of "service." Such activities cover the publication of a plant newspaper, which is another clearing house. It clears the news of the plant. Before establishing such a publication, the lack of a medium for getting the management and men closer together has been felt. A wider acquaintanceship among individuals has resulted from its establishment, and the development of an esprit de corps has been made possible.

The operation of a suggestion system also comes within the scope of betterment departments. A reward for suggestions affecting the economy and efficiency of an organization is justly due, and through this medium the ideas of workers are communicated for the impartial consideration of the proper executive, and great savings have resulted through the adoption of ideas so developed. Workers have thus been stimulated to observe and think and reap a financial reward for so doing.

Activities such as all of the foregoing have established a new profession; the employment or personnel executive is now in great demand. No executives in industry have a greater opportunity to play an important part in the social reconstruction that may follow the war than this group of men. The cycle that they have reached in the development of their work depends upon the individual case, but as a rule they are all moving forward toward the idea of more intelligent administration of questions of human relations. Their problems are those connected with adjusting minds to meet and thus bring about harmony. Surely no agency can play a more important part in meeting the great problems of the future.

Sea-Weed for War

(Concluded from page 231)

for nitrated gun cotton, and so essential in making smokeless powder for big guns and small-arms. Early in the war one of our big powder companies took a huge British contract for making cordite, which is the standard British propellant for both infantry rifles and big guns. Cordite is composed of about 25 per cent nitroglycerin and 75 per cent gun cotton. There are other minor ingredients which make this proportion slightly inexact but that does not matter here. In making cordite, acetone is required to dissolve the nitrated gun cotton, to permit the mixture of the nitroglycerin, and to turn the mass of fibrous stuff into the horn-like colloid in which the rate of burning is restrained, and which can therefore be used for propelling missiles from guns. About 40 pounds of acetone is used in dissolving 100 pounds gun cotton and the proper proportion of nitroglycerin.

Like many another taker of foreign war contracts, when the powder people turned to look for the raw materials for making the stuff for which they had contracted, the raw materials weren't there. It is this little joker that has put many a big plant into the hands of the financial Philistines since war broke out. It was for this reason, not because of any anxiety as to the potash situation, that the powder company hurriedly installed a giant plant out on the shores of the Pacific, about one and a half miles south of San Diego, to cozen acetone from the leaves and stems of the brown kelp lining the nearby shores.

To date the company has spent something like one and a half million dollars on this plant, recklessly throwing out machinery and tanks and stills for old processes when something better was stumbled on. They frankly admit that thus far the plant is mostly like the old western silver mine—a hole in the ground with a lot of your money in it—and that the total value of the products have not begun to pay for the plant. But it did make the cordite contract possible; and it is to be suspected that enough profit lay in that to keep the company over a hard winter.

Visitors, to put the matter mildly, are not encouraged at the plant. It is situated out on a lonely point south of San Diego, and but a long rifle shot from the international boundary that marks Mexico's north line. Because of the strange and delightful habit of bursting into flames with a preliminary explosion or two that is possessed by factories making munitions for the Allies, the company has surrounded the land side of the plant with such little discouragements to German kultur as tight and high barbed wire fence, well armed and alert sentries, searchlights and a machine gun or two. The coming of our own participation in the war didn't at all let down the bars, it added a company of infantry instead.

Wherefore we were bidden to pause a half mile or so from the great cluster of ugly buildings and giant tanks, by the matter of a chain across the road and a gentleman with a gun. After having thoroughly aroused his suspicions, we were sent on down to the plant gate, where we passed the infantrymen, and came to the high barbed wire and the guard-house of the company's own trained and uniformed guard force. More quizzing, gentle separation from a camera, a search for matches, arms and seditious literature, then a march to the office, where we were rescued by the genial and kindly Assistant Superintendent Bonfield, to whom we are indebted for the technical data and the information in general as to the great plant.

Also there came galloping out to meet us, before we got even to the outpost, a smell that would cause women to faint, and strong men to hesitate. It didn't smell like anything else in the world, but once smelled it is never forgotten. Enjoying it, we could sympathize with the poor soldiers camped in the midst of its glories, but they didn't seem to mind it.

It is this peculiar scent of rotten kelp that has caused "ructions," where plants have been installed for the conversion of the kelp into potash, and it caused the powder company much tribulation until it was "removed," as they fondly expressed it. It has been tempered, possibly, but the scent of the rose clings to it still. San Diego has given over the notion of pulling up stakes and leaving for other scenes and the odor, I am told, never reaches the city now—but things were different in the early days.

At this great plant the old and slow and wasteful method of calcining the kelp is not used. At present there is no definite and settled method; every month brings some improvement, and the company frankly states that, in spite of the huge expenditures, the plant is more an experimental than it is a producing one, although it is using some 1,100 men, and is working night and day. Tens of thousands of dollars worth of abandoned machinery testify to the fact that the accepted process of today may turn out so slow and so inferior to a newer one that it is cheaper to start all over again.

The plant, in addition to various still houses, separators, etc., consists of 156 giant "digestive" tanks, made of wood and open at the top, with a total capacity of 7,800,000 gallons, or roughly 50,000 gallons per tank. There are also nine storage tanks holding 400,000 gallons each.

The process of obtaining the ketones and the potash salts is one of fermentation —or in plain English, rotting; wherefore the scent that pervades the whole. There is practically no fibre in the kelp, nothing but a peculiar watery structure that breaks down very readily.

The kelp is harvested by the great cutters, self-propelled, which remain out in the kelp beds week after week, save during very heavy weather or the forced suspension of cutting by orders of the state officials. A floating machine shop keeps the cutters in repair, while barges handled by tugs convey the cut and macerated kelp to the wharf at the plant.

The cutter is merely a great marine harvester, with knives working under water, and conveyors carrying the cut plant up an inclined stage to the macerating machinery on the boat. The macerated kelp is then pumped into the waiting barges and the barges towed to the wharf at the plant.

Mixed with water, the macerated mass of brown leaf matter is pumped to the

(Concluded on page 240)

Sea-Weed for War

(Concluded from page 238)

digestive tanks. Through the great battery of 15 x 18 foot tanks there is a very complete, albeit badly rusted, installation of huge pipes to aid in the handling of the liquor.

Once in the tanks, fermentation—rotting—of the leaf is started by the aid of heat—steam—and a little mother-liquor to aid in the culture. At the end of about thirty days, when the chemists say the process has gone far enough, the leaf matter is screened off as far as possible and the liquor pumped into other tanks, where lime is added to sterilize it and stop the fermenting process.

The liquor is then heated and run through a Dorr thickener, whence something like ten per cent of the previous bulk is run into great filter presses where the mud is got rid of. The greater part of the water is removed by two quadruple Kestner multiple-effect separators without precipitating any of the contained salts; then the liquor goes to vats for further evaporation.

Finally it is run to the "hot and cold house," containing a dual set of vertical tanks, a hot side, and a cold side. The acetone-bearing salts are precipitated on the hot side—still containing, of course, much potash—while the potash salt is precipitated on the cold side. Here one finds a whitish powder, not unlike wet salt; this is the potash salt, potassium chloride, better than 90 per cent pure. It is conveyed to centrifugal machines and there dried to remove surplus moisture.

The acetone-bearing salts, taken off the hot side of the precipitating house, are taken to a still-house, and heated to about 900 degrees, taking off the resulting gas and sending it to a condensing house where the gas is again converted to a liquid. There is a final distillation where the various volatile liquids are taken off at various points on the still, these being of the ketone group.

Some of the by-products of the reduction of the kelp to the potassium chloride and acetone are potassium iodide, lime used for the digestive tanks; and, experimentally, the little known sodium alginate, obtained from the mud, and used as glue and sizing in the industries. The mud itself still contains valuable fertilizing elements and nearby ranchers haul it away to put in the orchards.

When visited in 1917 the plant was handling about 1,200 tons of kelp per day, with a capacity of about 1,500. At 1,200 tons of kelp per day the plant produced roughly 13 tons daily of 95 per cent pure potassium salt, about 350 gallons of acetone, and smaller quantities of the other by-products. Acetone is worth from two to three dollars per gallon.

The production of the latter is not unattended with danger. Acetone is a highly volatile and beautifully inflammable liquid, and a misplaced lighted match, or a kultur arrangement of thermite, would touch off a most impressive set of fireworks. Wherefore the great precautions taken to keep away unbidden guests and to prevent the unbiquitous fool workman who is willing to take a chance, from bringing matches into the plant. An incoming shift while we were there was stopped very briskly by the guards and the men searched for contraband of various sorts.

The handling of the kelp at this plant has brought in its train a mysterious and frightful electrolysis that is eating up every iron and steel rail and wire and nail in the place. The steel rails look as though they had been treated with strong acid. Another mysterious happening is the fact that the ringing of the various telephones from the plant's exchange, effectually puts out of commission the plant's wireless. No search for wrong connections or grounds has yet solved the problem, although the wireless and the telephone get along well enough at other places.

Probably, like coal tar, not all of the possibilities of kelp have been realized. A Los Angeles chemist claims to have produced handsome and permanent dyes from ordinary kelp. Another chemist at one of the many small reduction plants alleges that he has extracted from the kelp a superior quality of mineral water, equal to any mineral water in analysis and superior in smell—all of which is probably true, particularly if value depends on amount of odor.

Manufacture of Printing Ink

IT is well known that it is a very difficult matter to entirely remove printing ink from old journals which are employed in the manufacture of paper. A recent European patent relates to the preparation of ink by the use of what are known as the sulfur coloring substances, either black or in various colors, and in this way the color can be entirely bleached out by chlorine. In this way the inventor claims to be able to secure a good white paper and at the same time the printing ink is quite satisfactory.

NEW BOOKS, ETC.

PSYCHICAL PHENOMENA AND THE WAR. By Hereward Carrington, Ph.D. New York: Dodd, Mead and Company, 1918. 8vo.; 363 pp. Price $2 net.

In this book a writer long identified with the psychical research movement has collected many stories of the return of the dead. It must be confessed that, to the impartial reader getting them at fifth- or sixth-hand, not many of the tales end on a convincing note; a very few, notably the quotations from Sir Oliver Lodge, present curious features that might repay further investigation. The first part of the work, however, avoids the supernatural, and studies the mental reactions of the soldier; here we find ourselves on surer ground, in a most promising field, and while the author's generalizations may be too broad, he performs a distinct service to psychology and the public by introducing such works as Le Bon's "The Psychology of the Great War" and Dr. Crile's "Mechanistic Conception of War and Peace," at the same time giving us observations of his own that are the result of an experienced eye and a trained interpretation.

MILITARY SIGNAL CORPS MANUAL. Compiled by Major J. Andrew White, Chief Signal Officer, American Guard. New York: Wireless Press, 1918. 8vo.; 578 pp.; illustrated. Price, $1.50 net.

The Signal Corps, suddenly expanding from a small body of men to one of immense proportions, finds the information for its guidance scattered through innumerable separate publications—if it finds it at all. Major White, regarding the Signal Corps rookie as a sort of Mahomet, makes a commendable and largely successful effort to bring the mountain to him in concentrated form. His Manual seeks to include every essential of the vast fund of knowledge needed by the Signal officer in the discharge of his duties. Telegraphy, telephony, wireless, flag and lantern codes, drill regulations and field service are all set forth in unmistakable language; organization, drill instruction, and technical instruction and apparatus are clearly explained for the benefit of those about to take the field, those who by home study are preparing to serve the colors, and especially for those who have in hand the instruction of the younger generation as cadets. It will be welcomed with open arms by the men who have floundered through seas of print often only to fail in finding answers to their questions.

THE LITERARY DIGEST LIBERTY MAP OF THE WORLD WAR. New York: Funk and Wagnalls Company, 1918. Price map cloth, $4.50.; with wall hanger and roller, $5.50; bond map paper edition, $2.75.

A good map is the greatest aid to a visualization of the war and what it means. Facts conveyed to the brain by way of the eye make a sharper and more enduring impression than those taking any other path. Here we have, vividly symbolized, the situation as it existed on the Western Front on May 18th, 1918. The unusual size of the map admits of the depiction of the country on a scale of eight miles to the inch, showing not only hills, towns and all places of military importance, but also railroads and highways. On the same sheet is a complete map of the whole field of operations, with all fighting fronts, the British Isles, the whole Mediterranean, and as far east as the Persian Gulf. This also defines the limits of the submarine blockade, and provides a means of following the routes of the air raids that from now on will rapidly increase in extent and importance. A special insert maps out the coal and iron areas and furnishes information vitally connected with the war. The striking coloring, well defined boundaries and clear place names mark the publication as an excellent piece of work, and it is already used and commended by Government Departments and Army and Navy Commanders. A most convenient accessory is the separate index which accompanies each map and makes reference to any place particularly easy. The Western line of battle is shown in red, white and blue and indicates the positions occupied by the American, French, British and Belgian armies; every bend and salient is there, with the woods and the rivers that have played so great a part in the four years of fighting.

THE WAR AND THE COMING PEACE. The Moral Issue. By Morris Jastrow, Jr., Ph.D., LL.D. Philadelphia and London: J. B. Lippincott Company, 1918. 12mo.; 144 pp. Price, $1 net.

The author of "The War and the Bagdad Railway" demonstrated in that notable work how a purely commercial enterprise was transformed by Pan-Germanism into an imperialistic weapon; the moral issue involved was pointed out, and in this succeeding work the issue is traced and dissected through many of its ramifications. The problem is regarded as the result of misused power; in its solution the author buries himself not so much with the terms of the coming peace as with the general conditions necessary to universal peace. The book aims at the crystallization of public opinion, the exertion of this rejuvenated influence upon statesmen and diplomats, and the consequent avoidance of conditions that have heretofore left the world largely at the mercy of an unscrupulous power or group of powers.

PATENTING AND PROMOTING INVENTIONS. By Mois H. Avram, M.E. New York: Robert M. McBride and Co., 1918. 8vo.; 174 pp. Price, $1.50 net.

Many inventors have ideas of real value, yet not one in a thousand achieves financial and industrial success. From the inception of the idea to the marketing of the patent—if he is fortunate enough to get so far—a bewildering series of snares beset his feet. Mr. Avram comes forward with a really unprejudiced and meritorious text that cites the general causes of failure, reviews the patent laws in a simple manner, shows how advice and protection should be sought, speaks of the reliable and the unreliable patent attorney, and particularly impresses upon the reader the necessity for cooperation with the trained expert. Nor does it stop here, but gives most helpful suggestions as to evaluating the patent and promoting the invention. There is not the least doubt that inventors might save much vain labor, time and money by acquiring and putting into practice the knowledge offered by Mr. Avram's work. It recasts the principles of efficiency for the especial benefit of a class that has urgent need of them; its warnings are straight to the point and its advice is sound.

OFFICERS' MANUAL. By Colonel Jas. A. Moss, U.S.A. Menasha, Wis.: George Banta Publishing Company. 12mo.; 352 pp.; illustrated. Price, $2.50.

A MANUAL FOR POST EXCHANGES. By Floyd D. Carlock, U. S. A. Menasha, Wis.: George Banta Publishing Company. 8vo.; 206 pp.

MANUAL FOR QUARTERMASTERS. By Lieut. Colonel Alexander E. Williams. Menasha, Wis.: George Banta Publishing Company. 12mo.; 133 pp.; illustrated. Price, $1.10.

FIELD MUSICIAN'S MANUAL. By Lieut. J. Canty. Menasha, Wis.: George Banta Publishing Company, 1918. 12 mo.; 219 pp.; illustrated.

Subalterns will continue to find in Col. Moss's "Officers' Manual," now in its sixth edition, a very good friend and mentor. It packs into small space much information about the unwritten laws of the service, a knowledge of which will enable the inexperienced to avoid many an uncomfortable nook and embarrassing corner; by it they may smooth their angles into curves with the least possible friction. There are suggestions to the newly appointed, the etiquette of the salute, the duties of post officers, and the essentials of discipline, together with many other pointers of importance. The author of "A Manual for Post Exchanges" writes for the man with little or no bookkeeping experience. He cites the regulations and presents the accepted modes and forms of exchange accounting, devoting much space to special problems. Officers and non-commissioned officers responsible for administration and supply should also find valuable suggestions in this guide. In a "Manual for Quartermasters" Lieut.-Col. Williams deals with the multifarious facts and duties that confront the quartermaster. Personnel, transportation, supplies, property and finance are the headings under which this information is imparted. Lieut. Canty's "Field Musician's Manual" has been adopted by the War Department as the official Army textbook, and is a condensed but comprehensive presentment carrying plain instructions for beginners. The general duties of the office are detailed in the first part of the work; the second part is devoted to bugle music and the standardized calls.

NELSON'S HISTORY OF THE WAR. Vol. XIX. By John Buchan. New York and London: Thomas Nelson and Sons. 12mo.; 300 pp.; with maps. Price, 60 cents net.

The 19th volume of John Buchan's popular history of the war deals with the Spring campaigns of 1917, from the German retreat in the West to the progress of the Russian revolution; it includes the battle of Arras, the second battle of the Aisne, the campaigning in Mesopotamia, Syria, and the Balkans, and Italy's activities since the fall of Gorizia. No less than 35 maps place terrain and operations sharply before the reader, and there are the usual appendices made up of important dispatches from generals on the various fronts. Written in a most readable style, the work does not sacrifice accuracy and thoroughness in an effort to be entertaining, and it offers an inexpensive and easy way of acquiring a real knowledge of events, making an invaluable book of reference.

THE LOCOMOTIVE. Vol. XXXI. 1916 and 1917. Hartford, Conn.; The Hartford Steam Boiler Inspection and Insurance Co. 8vo.; 258 pp.; illustrated.

The bound volume of that interesting quarterly, *The Locomotive*, includes the numbers from January 1916 through October 1917, and is crowded with the usual informative little articles and news notes of educational value. Nor is the subject matter by any means confined to the locomotive; there are house heating suggestions, long lists of stationary boiler explosions, a summary of inspectors' work since 1870, papers on successful improvisations and devices of many kinds, and useful tables. The saving of fuel receives timely emphasis, and a touch of humor is contributed by stories such as that of the bank president who attributed the presence of grease and scales in the boiler to the fact that he had discovered the engineer broiling fish in the boiler furnace.

A B C OF THE ARMY. Compiled by Captain J. Atkinson. London: Gale and Polden, Ltd. 12mo.; 150 pp.; illustrated. Price, 1s. net.

STRIPES AND TYPES OF THE ROYAL NAVY. By F. W. R. M. and J. S. H. London: Gale and Polden, Ltd. 12mo.; 64 pp. illustrated. Price, 1s. net.

THE A B C OF THE UNION JACK. By Cecil H. Crofts. 8vo.; 24 pp.; illustrated.

The "A B C of the Army" is a pre-war compilation that will familiarize readers with that "contemptible little army" of Britain which, under the driving of necessity, has grown to a marvellous organization of millions. It conveys a general acquaintance with military knowledge and should lead to a better appreciation of the service rendered civilization, even in peace times.

(Concluded on page 244)

NEW BOOKS, ETC.

(Concluded from page 242)

by a well-regulated standing army; it explains the composition of this great national machine, the constitution, dress, and customs of the cavalry, artillery and infantry, the duties of the many corps and departments, and the nature of the reserves, the territorial army, and the Indian army and colonial forces. "Stripes and Types of the Royal Navy" contains correctly colored sketches from life that show the dress of all ranks and ratings from admiral to boy signaler, while the page facing each sketch briefly describes the duties of the rank or rating depicted. "The A B C of the Union Jack" traces the evolution of the British flag from the red cross of St. George blazoned on the surcoat of the crusader to the combination of the three crosses of St. George, St. Andrew and St. Patrick as incorporated in the present flag. All three books are well illustrated, the last two in vivid colors.

KEEPING OUR FIGHTERS FIT. FOR WAR AND AFTER. By Edward Frank Allen. Written with the cooperation of Raymond B. Fosdick, Chairman of the War and Navy Departments, with a special statement by Woodrow Wilson. New York: The Century Co., 1918. 12mo.; 207 pp.; illustrated. Price, $1.25.

It will be reassuring to all those who have fighting men in the camps to know that their comfort, happiness and safety are being so well looked after by the Government. This book tells the story, from the time when the author was sent to the Mexican border to study the problem of the soldier's environment to the present provisions for supplying our men with the comforts and amusements that go so far toward counteracting the tendencies toward dissipation that are born of homesickness and monotony. Our cantonments now have their club life, their educational and recreative athletics, their "singing schools" and their libraries. The theatre is an appreciated feature, and hostess houses provide rest rooms and a home-like atmosphere. All these things have been found to have a direct influence upon the problems presented by drink and disease; hence they contribute not only to health of body and peace of mind, increasing fighting efficiency, but their effect cannot fail to stretch forward to times of peace, and those who have fought for us will be not worse citizens than before, but incomparably better. This is the message of cheer carried by the author to all friends of the soldier and the sailor.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(14291) E. D. B. asks: Can you answer this question? Sound travels about 1,100 feet per second in air. Suppose the sound started at a point 70 miles above the earth, coming down at an angle of about 60 degrees would the above velocity remain constant, the sound waves moving from a very rare atmosphere to the earth, the density of air increasing. Triangulation of a meteorite here, explosion point, and angles on 100 mile base gain in height of 70 miles. The sound (from various observers), averaged 2 minutes which would be 24 miles. The two do not check up, and this caused me to ask the above question —your reply will be very greatly appreciated. A. Your error in estimating the height of the meteor from the time after the explosion till the sound was heard arises from not allowing for both the density and the temperature of the air at great altitudes. At a height of 70 miles the air is excessively rare and cold. The velocity of sound is inversely proportional to the square root of the density of the air; that is, if the air is one quarter as dense as at the surface of the earth sound would travel twice as fast. One quarter of the pressure is at about 7 miles above the sea level. What the pressure is at 70 miles above the earth no one knows. It is but a small fraction of an inch at the most, and sound will travel many times as fast there as at the surface of the earth. This would diminish the time for the sound to come from the meteor to the ground. On the other hand the lowering of the temperature will cause the sound to travel slower and increase the time between the flash and the report. At the very low temperatures at an altitude of 70 miles, the velocity of sound is not far from six-tenths that at the temperature of freezing. From this you will see that no reliable estimate of great altitudes can be made from the velocity of sound. Triangulation gives the most reliable result.

(14292) L. A. S. asks: What is the variation in weight between 100 pounds of iron, molten at a white heat and the same metal chilled? A. One hundred pounds of iron weighs 100 pounds in any form in which it can exist. Even if it were boiled away to a vapor, the vapor would still weigh the same as the solid iron whether the solid is hot or cold. A certain mass of matter has a weight because the earth attracts it by the force which we call the force of gravity, and that matter is the same matter if it be a solid, a liquid or a gas. The iron has the same weight cold or hot, molten or solid.

LEGAL NOTICES

Annual Subscription Rates for the Scientific American Publications

Subscription one year..... $4.00

Postage prepaid in United States and possessions, Mexico, Cuba and Panama.

Subscriptions for Foreign Countries, one year, postage prepaid..... $5.50

Subscriptions for Canada, postage prepaid.... 4.75

The Scientific American Publications

Scientific American (established 1845)..... $4.00

Scientific American Supplement (established 1876)..... 5.00

The combined subscription rates and rates to foreign countries, including Canada, will be furnished upon application.

Remit by postal or express money order, bank draft or check.

Classified Advertisements

Advertising in this column is $1.00 a line. No less than four nor more than 12 lines accepted. Count seven words to the line. All orders must be accompanied by a remittance.

SCHOOLS

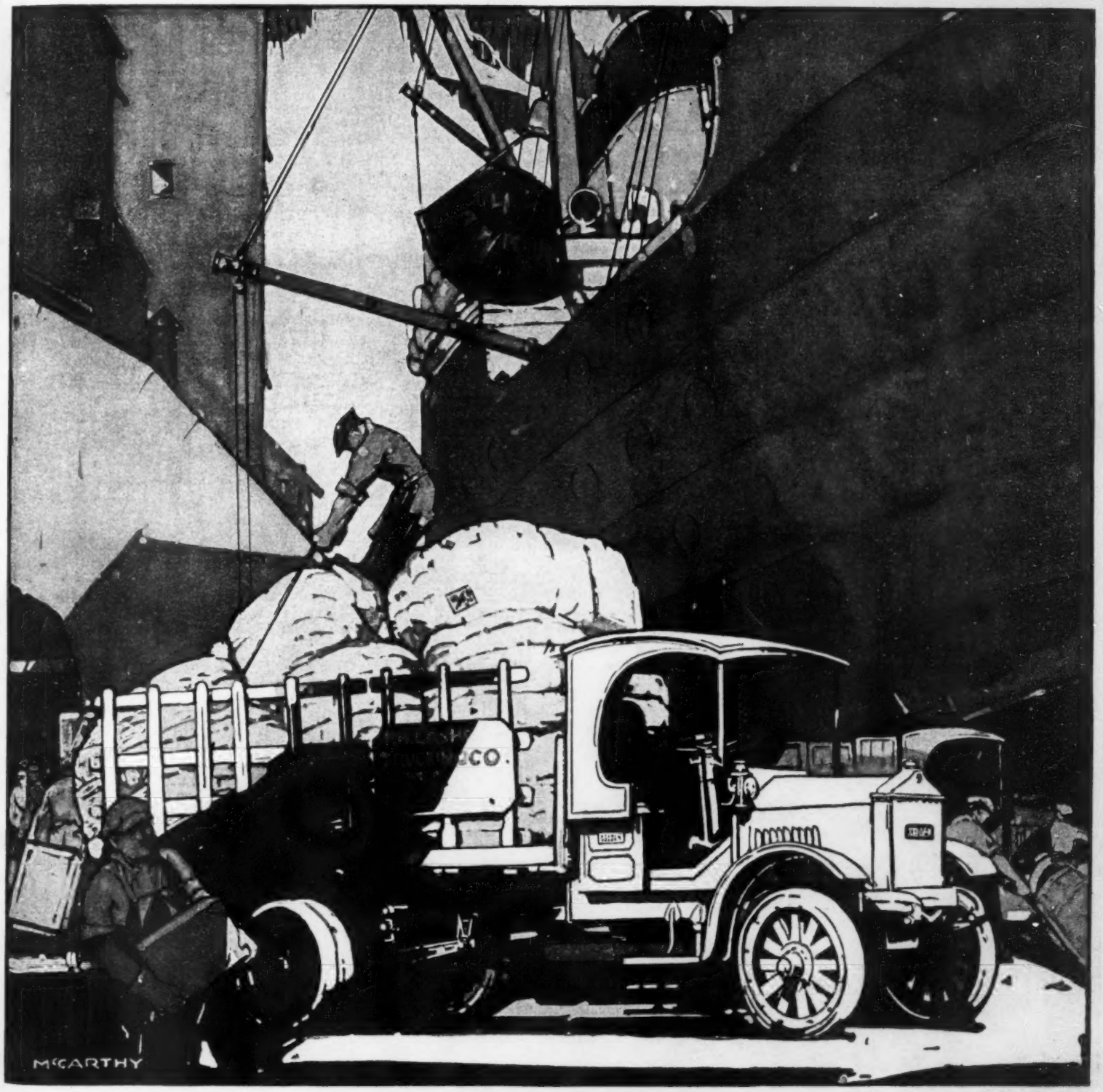
MANUFACTURING OPPORTUNITIES

BIG MONEY IN MATCHES. I sell machinery for making. W. E. Williams, 28 E. Jackson Boulevard, Chicago, Ill.

FOR SALE

TIME CLOCKS—Rebuilt Dey, Cincinnati and Simplex always on hand. Time stamps, Calculagraphs. Nothing but time recorders and supplies. Time Register Repair & Supply Co., Gardner, Mass.

Selden Trucks



Whenever *the power to endure continuous hard service at low operating cost* was the requirement of the hauling job, no Selden Truck ever failed to render *profitable service.*

1, 2, 3½ and 5 Ton Worm and Internal Drive Models. Write for Full Information.

Buy a SELDEN—It's ALL Truck

SELDEN TRUCK SALES COMPANY

ROCHESTER, N. Y., U. S. A.

THE "BULL DOG"

Mack TRUCKS

Through Service

Full-powered, like a giant locomotive, the MACK truck sweeps over the world's highways. It follows no prescribed track but moulds its routes according to the demands of transportation.

From Bethlehem, Pennsylvania, to Waterbury, Connecticut, the MACK truck has rushed special steel to eager factories. In the Arizona desert, MACK trucks hauled materials for the Roosevelt Dam. They carried cement and steel for the famous Catskill Aqueduct. A MACK, with a 10 ton casting for the Carnegie Observatory, climbed the steep road up Mount Wilson.

First manufactured twenty years ago, the MACK introduced the motor truck idea in the United States. Years of practical experience have brought refinements of design and improvements in construction, till today the MACK is the most endurable performance truck on record. In Los Angeles, a MACK truck has traveled 50,000 miles with an actual cost for repairs and parts of less than $20.00.

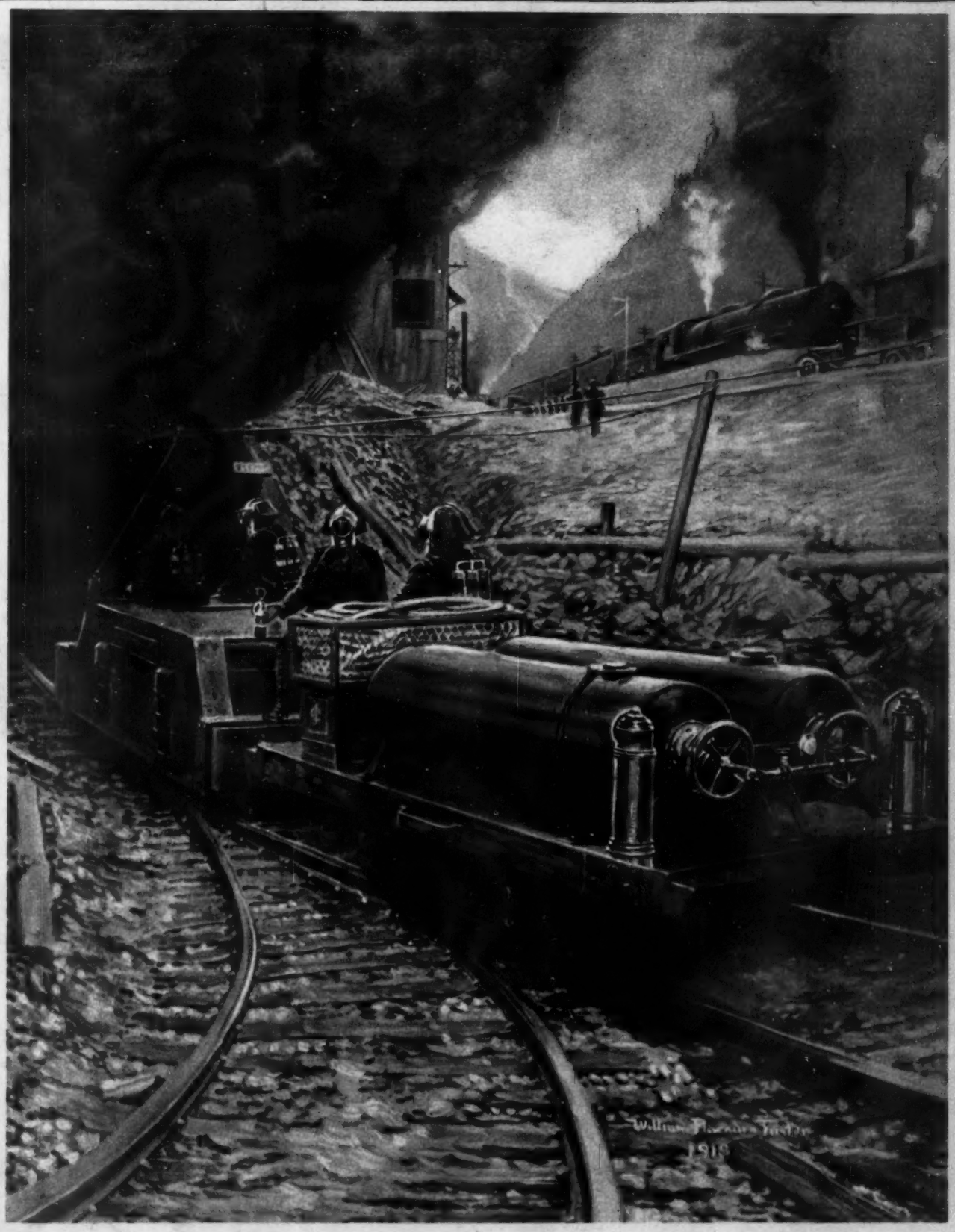
MACK capacities:— 1, 1½, 2, 3½, 5½, 7½ tons. Tractors, 5, 7, 11 and 15 tons. Write to Department "O" for catalog.

INTERNATIONAL MOTOR COMPANY
NEW YORK

PERFORMANCE COUNTS

SCIENTIFIC AMERICAN

Entered as second class matter June 18, 1879, at the post office at New York, N. Y., under the Act of March 3, 1879.



THE CHEMICAL ENGINE COMPANY RUSHING TO FIGHT A FIRE IN A COAL MINE

Vol. CXIX. No. 13
September 28, 1918

Published Weekly by
Munn & Co., Inc., New York, N. Y.

Price 10 Cents
$4.00 a Year

Hess-Bright Ball Bearings

Understand What Bearings Must Do

You regard the strength of axles and shafts as of prime importance. Possibly you leave the matter of bearings to others.

Yet the ball bearings must carry the same load as the axle—must stand the same strain as the shaft. That's why they are *all* important. If you will insist on Hess-Bright Ball Bearings you will get service. For each is built to stand a certain load—with an excess to spare. Their making guarantees their service and this in turn your satisfaction.

THE HESS-BRIGHT MANUFACTURING COMPANY

Where Performance takes Preference over Price